IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF OREGON

PORTLAND DIVISION

UNITED STATES OF AMERICA, Plaintiff, v. W. JOSEPH ASTARITA, Defendant.	Case No. 3:17-cr-00226-JO May 24, 2018 Portland, Oregon

EVIDENTIARY HEARING - DAY 4

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TRANSCRIPT OF PROCEEDINGS

BEFORE THE HONORABLE ROBERT E. JONES

UNITED STATES DISTRICT COURT SENIOR JUDGE

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TRANSCRIPT OF PROCEEDINGS

(May 24, 2018)

(In open court:)

MR. MALONEY: Is the Court's invitation to have members watch from the jury box still open?

THE COURT: Just a moment. Say it again.

MR. MALONEY: Is the Court's invitation to have witnesses and other members of the gallery observe from the jury box?

THE COURT: Yeah.

MR. MALONEY: Okay. We have one witness who asked permission to do that. I told him it was okay, but I wanted to make sure.

THE COURT: I had encouraged people to do that, and they don't want to take me up on it.

MR. SMITH: I gladly will. The benches are uncomfortable.

MR. MALONEY: Thank you, Judge.

THE COURT: Yeah.

MR. FRANCIS: Your Honor, if I speak with the microphone here, are you able to hear me?

THE COURT: Speak into the mic, please.

MR. FRANCIS: Apparently not.

Your Honor, I was asking if you could hear me in the microphone in that position.

THE COURT: I can hear you perfectly now.

MR. FRANCIS: Thank you very much.

THE COURT: I want to warn you I can hear you whisper.

MR. FRANCIS: I'll try to avoid that. Thank you, sir.

DEPUTY COURTROOM CLERK: Raise your right hand, please.

EUGENIO LISCIO,

called as a witness in behalf of the Defendant, being first duly sworn, is examined and testified as follows:

THE WITNESS: I do.

DEPUTY COURTROOM CLERK: Thank you. Please have a seat. I'll give you this.

THE WITNESS: Thank you.

DEPUTY COURTROOM CLERK: Have a seat. Speak directly into the mic. Spell your first and last name for the record, please.

THE WITNESS: Good morning. My name is Eugene Liscio. L-i-s-c-i-o. And my first name is legally spelled Eugenio.

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DIRECT EXAMINATION

BY MR. FRANCIS:

Q. Good morning, Mr. Liscio.

A. Good morning.

Q. Mr. Liscio, tell me a little bit about your background.

A. My background is in aerospace engineering. I graduated from Ryerson Polytechnical University in Toronto, and I started my career at McDonnell Douglas, which eventually became Boeing. I worked in the materials and process engineering lab, and I did failure investigations while I was there.

Eventually, I went to another aerospace company in Buffalo, and there I -- I worked in the service department, and we worked with laser-based instruments, and I did some 3D work at that time. And eventually what I did was I jumped into forensics. I had an idea at the time that I thought it was interesting, and so in 2005 I began my own company. And the company is called AI2-3D, and it stands for Animation, Imaging, and Illustration and of course the 3D.

Basically, what I do today is work on homicide cases or criminal cases. I have some civil component to my work, and what we do is use 3D technologies to do some type of analysis, documentation, or visualization.

So some of the -- perhaps the most notable case that I worked on was the terrorist shooting that we had in our Canadian Parliament in 2013, and I was asked by the RCMP and

OPP to assist with that with the investigation.

In addition to my work there, I'm also an adjunct professor at the University of Toronto. They have a forensic sciences program there, and I teach a fourth year course. It's a course that I developed myself. It's called 3D Forensic Mapping and Reconstruction.

Part of that course or the idea behind that course is to use 3D technologies to help analyze or solve problems in forensics. Some of those problems might be bullet trajectories. They could be blood stain pattern analysis. It could be suspect height analysis. It could be clandestine graves, toolmarks. And so it uses a wide variety of 3D tools, including laser scanning, photogrammetry, things called structure-like scanners, CT scanners, microscopic scanners. It's a wide range of tools.

One of the benefits of being at the university is, of course, you get to work with very eager students, and so, as a result, we do research there. We do validation testing, and a number of which I've identified on my CV, and I continue to do that for both graduate and undergraduate students which I'm mentoring.

Q. Speaking of your CV, you have a binder in front of you which contains what's been marked as Exhibits 10-1 and 10-2. Can you take a look at those? And they might simply be marked as Tab 1 and Tab 2 for that binder.

MR. MALONEY: Your Honor, no objection to 10-1 and 10-2.

THE COURT: They're received. You don't need to pursue it further.

MR. FRANCIS: Thank you.

BY MR. FRANCIS: (Continuing)

Q. Mr. Liscio, are you familiar with photogrammetry?

A. Yes, I am.

Q. Is that a -- could you explain what experience you've had in the field of photogrammetry?

A. The beginning, for me, in photogrammetry was in 2006 where I had training on photogrammetry, which was actually PhotoModeler, and that is a software package which is a comprehensive photogrammetry package.

Eventually, I went on to learn other software packages like iWitness. There's another one called Elcovision, which is a Swiss product. And I've worked very closely with the developers of this software to help improve, to do beta testing, and a number of different things.

Also -- so some of the papers which I've published include a photogrammetry component, and a lot of the research at the school and everything else is along those lines, including teaching.

So just -- just a few weeks ago I was training the FBI in Michigan on photogrammetry. I've held my own courses in

photogrammetry. About three or four weeks ago, I was also in Niagara Falls, Canada, where I was asked to teach an almost weeklong course on suspect height analysis to a group of 30 police and how we can use photogrammetry to make these types of analyses.

Q. What about camera matching? Is this a method that you've heard of before?

A. Yes. So camera matching has, I guess, some different names, and some people will call it "camera matching photogrammetry" or "camera matching," and so I am familiar with it. It is something that I looked at early on.

It is a method that I think may have been originally developed by people in the film and television industry. And the reason is that if you're doing film effects and that sort of thing, you want to be able to overlay something onto an image and make it look in the correct perspective.

So, for example, 3D Studio Max, which is the software that has been used in this particular case for this analysis, has its roots in the film and television industry.

Now, I don't want to degrade that at all because it's an excellent tool. It's used by forensic animators to model and animate things, so it's used in forensics. It's used in medical. It's used in scientific visualization and imaging. But camera matching comes in different forms.

So in terms of my use of camera matching, it is something

that I have not used in the form in which we have seen here at this trial.

Q. And why is that?

A. The basic reason is that it is the least scientific and it is the most subjective method of all the methods that are available to a person that's going to be using photogrammetry.

If we were to look at, for example, a hierarchy of what is available to people, at the very, very top of the list or the top of the pile you would say it was what's been termed here as analytical photogrammetry. And really what we're talking about there are the software programs which are available and using full-fledged computer packages which are dedicated to solving these kinds of problems.

As you start moving down the list, at the very bottom would be, for example, camera matching. Camera matching does no calculation. It's completely subjective, and it's entirely up to the -- the operator or examiner, and I think that was made very clear in Mr. Terpstra's testimony.

Now, having said that, there are situations where, when the evidence is presented to you, you get what you get sometimes. So the requirement of having a very, sort of, stringent analysis is that you want to try to get the best images possible. And sometimes those images are simply of a poor quality or there are other things that could happen.

So, for example, the environment could have changed

significantly. Like, for example, with snow, and when you go back it's very difficult to re-create those conditions. The camera may not be available. So, for example, you could have a fire in the building where the camera is no longer available.

So in order to do those types of analyses, you can, but you have to let go of some things, and you have to start moving down the list.

Q. So thank you for that overview. I think what we're going to do this morning is take -- take what you've just said and go into each of those parts in a little bit more detail.

A. Okay.

Q. So let me start by asking you this: Did you have an opportunity to review the analysis that Mr. Terpstra did in this case?

A. Yes, I did.

Q. And did you formulate an opinion on Mr. Terpstra's analysis of this case?

A. Yes, I did.

Q. What is that opinion?

A. There would be a few things there. So let me start with a review of the report. At first it wasn't entirely clear exactly what was being done, and so I had to clarify that, and I did -- I did speak with Mr. Terpstra on the phone, and he was very open and honest and very cooperative, and he was an absolute gentleman, so I appreciate all the help to -- for the

clarification.

Once it was clear what was being done, the method which was chosen, because of the quality of evidence, was manual camera matching. And the reason I say "manual camera matching" is that there are camera matching methods which do have a little bit of help, which help you a little bit.

For example, in 3D Studio Max here, in the software there's something actually called a camera match utility. It's a tool. And that tool is much like what the photogrammetry packages will have, except that it is not very comprehensive. It's a very low-level tool. It doesn't give you the same kind of reporting and that sort of thing.

So when somebody says "camera matching," you have to distinguish whether or not it was them that was doing the camera matching or whether they were using a tool or something like that.

Q. Why is that distinction -- I'm sorry to interrupt. Why is that distinction important?

A. Well, obviously, because it's the subjectivity. It's the examiner that's doing it. It's the examiner that is making the decisions. So that's the first part of the review and understanding the method and the quality of evidence, and I think we all agree that the evidence -- it's always nice to have better quality images. Unfortunately, we have what we have.

The second thing was to have a look at, for example, the -- the accuracy and the precision. So a couple of times, I believe, in the report there was a statement made that this is an accurate and fair representation, and in order to make that claim, you would -- you would expect some form of accuracy being provided. And the truth is, and as was admitted by Mr. Terpstra, there is no accuracy provided. It's, "Here it is," and that's it.

So to state that it's an accurate and fair representation, I think we have to look at it in the context of what we are asking the analysis to provide or to do.

In some cases, we're asking too much of that analysis, and it simply cannot provide what we need.

Q. What about this -- what about Mr. Terpstra's range of certainty that we've heard discussed yesterday?

A. Correct. And that was next, so --

Q. What was that?

A. I think we talked yesterday about accuracy versus precision. And accuracy, we know, is, for example, how close you are to a known value, and precision would be how close a number of measurements could be within themselves. And Mr. Terpstra provides a certainty. He provides a certainty. And it wasn't entirely clear for a little bit. But in a true photogrammetry analysis, the precision is different than what Mr. Terpstra has provided.

So what Mr. Terpstra has provided is, "I can move these objects within this visible range to me." So it's his decision to say, "This is what it is." It's not a true reporting of errors that comes back from a photogrammetry package and says, "This is the standard deviation," or "This is your type of precision."

The other thing that's important to note here is that in a 3D environment the precisions that need to be reported are not one number. There are three different axes that we have. We have the X, we have the Y, and the Z. So forward and back, side to side, up and down. And in a true photogrammetry package what you would end up with are three types of precision. And what you end up with is an ellipsoid shape, an oval, like an egg almost. It can be a sphere, but normally it looks like an egg, and it could be elongated.

So those were not --

Q. Let me unpack what you said just a second there. When you talk about it being an egg versus a sphere, am I correct that a sphere you meant that you have identical precision values front to back, side to side, up and down, so that a sphere captures all those because it's all evenly distributed around -- around the single point?

A. That's correct.

Q. And an egg would mean that some errors in some directions might be larger but errors in another direction might be

smaller. Am I understanding that correct?

A. That's correct.

Q. Now, in addition to the issues that you're pointing out with the way that Mr. Terpstra identifies his -- what we're now calling his precision, what he refers to in his report as his range of certainty, what were you able to tell about whether his range of certainty -- what that says about his accuracy?

A. Well, let me -- let me put it this way: I -- I've said before that we don't know what the accuracy is because we don't have a true measure to compare to. We don't even have another project to compare to. And Mr. Terpstra said this is a unique case, and I would agree. There's uniqueness here.

A key component of photogrammetry, which is different from a laser scanner or a total station, is that a total station and a laser scanner go to a manufacturer, they calibrate it, and they tell you, "This instrument is good to plus or minus X." 2 millimeters, 5 millimeters, whatever it may be. But they give you a specification. So as long as that instrument is used for typical applications, it's perfectly fine. You can deduce that. But even in those situations, even in those situations, we can't say it's 2 millimeters. You know, there are situations where it can be more or less, and you have to understand what those are.

But let's say, for example, I take the laser scanner and now I encase it in a glass box and I put it under water, it

would be a completely different environment and a completely different application, and it simply -- the accuracy doesn't carry over. It doesn't apply.

So in photogrammetry, the images that are being input, a whole number of factors, including the camera and the methods, need to be analyzed in order to say, "What can I expect?"

And so I just wanted to make this a very clear distinction that doing close-range photogrammetry up on a car, or something like that, is not the same as doing it, you know, from two miles away on a -- from an aerial platform.

Now, having said that, in my review of the images, in my review of the methods and everything else, the -- that certainty that was provided --

Q. Provided by Mr. Terpstra?

A. Provided by Mr. Terpstra in his report. It's clear to me that they are aggressive, and they are overstated, and they -- they don't hold back. They're overly aggressive for this type of project.

Q. Mr. Liscio, did you -- were you hired in this case to evaluate the work that Mr. Terpstra did?

A. Yes, I was.

Q. Did you do your own analysis of precisely where the people and trucks were relative to the scene and relative to each other?

A. No. I did not do my own camera matching or my own

analysis.
Q. Is it, in fact, possible to do such an analysis and give an answer that is as accurate as Mr. Terpstra thinks it is?
A. In my opinion, it is not. If I were to do this analysis, looking at the images, looking at the quality, and using the same methods, this type of analysis, we would end up at the exact same point as where we are, which is we don't have a measure of accuracy. So other measures, other things need to be considered, and other actions need to be taken.
Q. If we had asked you, for example, to analyze which of these three individuals that we've been talking about this week could or could not have fired round five, would you have been able to do so?
A. Not within the limits of accuracy that I would need.
Q. Why not?
A. And, again, it has to do with basically everything that I stated before, which is that the sensitivity of this project to errors, knowing what we know between the trajectory rods, the vehicle, the motion, and just the basic quality of the images themselves, we have some issues with that, and we simply cannot hold these extremely tight tolerances at that -- at that distance that -- from these images.
Q. Now, Mr. Liscio, you described the -- a hierarchy of different photogrammetric techniques that can be used to try to determine the location of objects within a scene, and you've

placed camera matching at the bottom of that hierarchy. I suspect you're going to be asked a question soon by the government about an experiment that we have been referring to as "the Coleman experiment," and is it your understanding that that experiment compared camera matching to PhotoModeler, the software that you described before?

A. That is correct.

Q. And are you aware of what that study found when it compared the accuracy of PhotoModeler with the accuracy of camera matching for that particular controlled experiment of a staged motorcycle crash?

A. Yes, I am.

Q. What do you think about that?

A. Well, there's a couple of things in the study. If we start at what it found, one of the things was that -- that, for example, PhotoModeler may not have been as accurate.

But if you look at the study closely, they actually put PhotoModeler at a disadvantage, and the reason is the other camera matching methods were using the point cloud data. And what they did in the PhotoModeler study was they replaced the point cloud data with mesh, and that mesh was not of fine detail, which means that if you pick on certain points of the mesh, you may not be at the right location.

So let me explain that.

If I have a surface on the side of a hill that goes up

a --

Q. You're making, for the record, a scooping motion?

A. That's correct. If you have, like, a hill, a curved surface -- and I just picked two points at the top and the bottom. I may miss out on the whole curvature in between because I'm making an assumption that I have a flat surface in between, and that is what they did.

So as a result, the numbers, again, put a true photogrammetry package at a disadvantage when it was fully possible to do so.

Q. Mr. Liscio, is there a generally applicable error rate for camera matching?

A. No, there is not.

Q. Why not?

A. As I said before, photogrammetry is unique in that it doesn't have a fixed manufacturer's specification. It is subject to the information that is plugged into it or provided to it, and that is the major problem with photogrammetry.

Q. And just to be clear about what you're saying here, does that mean that the better quality evidence that we put into a camera matching project, the more precise or accurate results we get out of that project?

A. That would be generally true.

Q. And, conversely, the more blurry or far away images are taken, the less precise and the less accurate the answers we

get coming out of it?
A. Again, that would be generally true.
Q. Can you take the accuracy measured in one photogrammetric experiment and take those numbers and translate them, extrapolate them, to all other scenarios of photogrammetry?
A. Absolutely not.
Q. Can you do as Mr. Terpstra claims he can do on the stand yesterday? Can you see whether particular points in an image appear to have similar characteristics and from there conclude that they have similar accuracies?
A. No, you can't.
Q. Why not?
A. Because the conditions, what you are measuring and where you are measuring it inside of a photogrammetry project is important. And so, for example, we have a couple of scenarios here where we have vehicles on the roadway surface, and then we have a vehicle which is off on a snowbank. And when using a photogrammetry analysis, almost all the published papers will tell you and recommend that if you have a surface where a point intersects, for example, a foot on the ground or a tire on the ground where it intersects a surface, and you can see it discretely, that's a important point. You have to very clearly see where that point is. That's the best method to be using.
But when you cannot see, for example, the underlying surface -- so, for example, tires that are covered by snow --

we have no idea if the suspension is higher or lower from the tires or there's some separation.

In fact, I've been at conferences before where very respected photogrammetrists have talked about things like suspect height analysis. So in a case where we have a camera here or in a bank where we have, you know, a person or a suspect, you measure their height. You can accurately define a point on the surface.

Q. Why is that? What is special or unique -- I think we've discussed in this case, and perhaps in some of the pleadings, scenarios where suspect height analysis was used in a bank robbery to determine the height of a suspect. What is -- what is different or -- about a situation like that from the situation we're presented with here today?

A. Well, aside from the fact that in a bank you're not miles away, obviously. Things are close. Often the resolution is better. You know, better than what we have here or whatever. But aside from that, the principle of being able to hit a point on the ground is somewhat technical, and it has to do with being able to -- having a light ray coming from the pixel in the camera and emitting out of the lens and then intersecting with that surface on the ground. And that's the principle.

But as soon as you come off of that surface, as soon as you start to go up to try and measure the head, you've gone from something which is analytical to subjective.

Q. And I want to talk about that subjectivity issue with you.

So we've heard -- we've heard you describe this morning that camera matching is a subjective process. We've also heard this week from the government that Mr. Clifford Mugnier's analytic photogrammetry is the old way of doing this type of analysis and that the way that Mr. Terpstra does it, essentially the computer is calculating it all for you.

Is that an accurate statement of the distinction between analytic photogrammetry and what Mr. Terpstra did in this case?

A. I heard the statement earlier this week, and there was sort of a misleading representation that somehow the computer was calculating something for you. There's no --

Q. Can you clear that up for us?

A. I'm sorry?

Q. I'm sorry. Can you clear that up for us?

A. I believe Mr. Sussman, on the first day, was talking about how Mr. Mugnier's method, analytical method, was the old -- and he said that -- I'm not paraphrasing this -- or rephrasing exactly, but that Mr. Terpstra was using the computer, and the computer was making calculations for you.

Certainly, the computer will read back to you where you may be. So for -- what I mean by that is if you take an object and move it here and it has a certain X, Y, Z coordinate. If I move it here or move it here or move it here, it will tell me exactly how far I've moved it or where the new position would

be.

But in the method -- in this particular method that was chosen, it is up to the examiner to input, to make that movement, to push and pull and do whatever he needs to do to position the objects. The computer does, in this method, zero. It does nothing.

Q. So when we've heard testimony about moving 3D models of vehicles and people so that they align with a background image or align with the way things look in a particular photograph, how is that alignment being determined?

A. Again, that is up to the examiner. And so in Mr. Terpstra's testimony yesterday, one of the -- one of the -- in one of my reports, I gave an example of if you went to one image and you moved one of the operators -- and he showed it yesterday.

And so, for example, one of my positions was different from his positions. And I believe he exemplified or he got the point or made the point for me. What he said was -- he didn't say I was wrong. What he said was "That position looks unnatural to me," and that's the key point here. We have a very blurry image. And so now it's between my opinion of what is natural and unnatural versus his opinion of what is natural and unnatural. I think that's the key point here.

Q. Would it be helpful for your testimony today to demonstrate to the Court what we're talking about here, that

the placement of people or vehicles in the scene is a subjective process? You have a laptop in front of you.

A. I could do that, yes.

Q. Just a moment, please.

A. I just need 20 seconds here. I'm just going to shut some things off here.

Q. Go ahead and take your time.

A. Okay.

Q. All right. What are we looking at here?

A. So this is Mr. Terpstra's file as it was provided to me, and this image which is on the screen is the image which was chosen for the analysis -- the previous shot five, if you will.

Q. If you'll allow me just to clarify that. Is this the -- is this the image that Mr. Terpstra did his report based on assuming that it was shot five?

A. Correct.

Q. All right. Go ahead, please.

A. All right. So what I want to show here is -- and as I move around -- I'll give you an example. So I'll move into this position here. I don't think I have to convince you that it's very difficult to see that there is a person there, and so if I were to ask you, "Can you see a natural position for a person," I think you would have a very difficult time trying to place that person.

Now, in all fairness, we have to use the video and look at

what's happening before and after and that sort of thing. But this is the image. You can only -- you're working with a frame in the software, and this is what you're up against.

So now I would ask you to imagine how you think that person might be there. I'll turn it on, and it's actually cut off. So I don't know if you expected it to be in frame or out of frame, but that's what it is.

Now, when I look at this, I'll say, well, it may look unnatural to me. How does Mr. Terpstra know his foot is up in the air and that his hands are this way? It's entirely subjective. It's problematic.

If I go back to this other area -- and I'm going to shut it off first before I show it to you because I want you to make your own decisions. But this is what we're working with here.

Q. What we're looking at now, as I understand it, is a zoomed-in portion of the image, and this is the -- I believe this is the triangle formed by the three blocking vehicles. Am I accurate on that?

A. Well, let me back out so you get --

Q. Yeah, okay.

A. I'm just going to move in to where we have these two operators here.

Q. And, I'm sorry, you're saying there's two operators there?

A. That's correct. There's one up in this corner. But the two in the center of the image at least. So, again, I would

like you to do your best to imagine how these people should be in this -- in this position, and I would like to know if -- well, I wouldn't like to know, but I'll just turn it on, and you can decide for yourself. Is that what you expected?

So when we talk about the wiggle room in this particular scenario, it's massive. It's massive. I mean, you can use the -- the before and after images and that sort of thing, and, again, if I move one person closer or farther, it's -- I'm making that decision based on what I feel is reasonable.

And the problem is is that somebody else may have a different opinion than mine. And so we're not stuck with one little bit of wiggle room. We have a wide range of things that happen, and this is why it was -- it was brought up earlier this week. When we're using a method which has a lot of subjectivity, blind tests are very important, and having multiple examiners is very important. So this is but one sample in what could be a very wide window.

And so we need more people to look at this and to attempt this. And actually one thing I -- I didn't realize until yesterday was that Mr. Terpstra had more than one person working on this project. There were multiple people working on this project, and they all did a piece of it; whereas, they could have all done it blind and separately and had a more objective answer to this -- to this problem here.

Q. So, Mr. Liscio, I'm going to push back on you a little bit

here because I think that one of the criticisms that you're going to get about what you're describing here is that we're only looking at one image. We're only looking at one of the 12 images that Mr. Terpstra claims that he relied on to do this. And I think we saw during Mr. Terpstra's direct examination that if you switch angles -- let's talk about the vehicles first, for example -- that if you switch camera angles to a different image of these vehicles, perhaps a clearer image of these vehicles, that if you wiggle those vehicles in the way that you're demonstrating or wiggle objects in the way that you're demonstrating, that when we switch camera angles you might see that wiggling from that other perspective.

A. Uh-huh.

Q. My first question is does that type of criticism of what you're explaining to us depend on all 12 images showing the vehicles in exactly in the same place throughout all 12 images?

A. I know you asked me to answer the vehicle question first, but because I'm on -- it's easier for me to --

Q. All right.

A. If I may, I would like to do the characters first.

Q. Sure. That's fine. You do have it up in front of you. So we'll come back to the vehicles. So let me ask you a different question, then, about the people.

A. Sure.

Q. For the people, we saw, during Mr. Terpstra's direct,

another angle of the people that showed -- well, why don't you -- why don't you explain to us the issue with that. You were here in court.

A. There was the -- the plus 35 frame at the time. There was another image that was used from a different angle to help locate some people. And I would like to bring that up because I think it's -- it's also important to demonstrate what that might be, and I think it might be this one. Just give me a moment.

Q. And what -- and just for the record, when you say "plus 35," are you referring to a frame of video from the FBI overhead camera that depicts the way these things were at a point in time that Mr. Terpstra believed was 35 frames after round five was fired?

A. Yes, that's correct. So, for example, it's this particular image here. It's labeled as 35F. So I just need to make sure that I have the correct one.

Q. While you're pulling that up, I'll ask you another question. Is it your understanding that the reason that this "shot five plus 35 frames" was selected as something we were all going to look at is because that is the first time in the video where we have the same scene being depicted from two different camera angles? The first time after round five was fired?

A. Yeah, I believe -- I believe that is correct.

Q. Okay. Go ahead whenever you're ready.
A. Okay. So what I have here is the -- this other camera match from the other angle, and I brought the background image in place here.

I'm going to move in here, and this -- this is the area where they've placed some people, and I would ask you to take a hard look at this one because there are people there. I'll zoom out so maybe you get a good reference, and I'm going to move into this area. You can see there's a tree here that's blocking. There are some other things going on here.

But I'm going to turn this on -- turn the people back on like that.

Now, there are some other positions here that he's placed, but --
Q. And, sorry, so you're wiggling back and forth between two different positions?
A. Yeah. This was in his file. But, nonetheless, it doesn't matter where I place these people. If I just turn this off and on, I mean, obviously, when we overlay the other people there, which are very, very difficult to see in this case, at some point we hit a brick wall, and we say, "We're stuck here. Maybe this is not a good frame to be using."

And so if this was used to validate the other position, we have some problems here.
Q. All right. Let's stay on the subject of people.

So there was a -- there was a criticism raised during Mr. Terpstra's direct examination of the way that you were able to wiggle people. This was during the briefing before this hearing. You performed an analysis where you were demonstrating the subjectivity of this exercise and you showed, essentially, "Look, I can wiggle these people, and you can't tell just by looking at this image." And they, during Terpstra's examination, showed that what you had to do in order to achieve that wiggling was to change someone's stance.

Can you talk about that, please?

A. If I understand the question properly, it -- it basically comes down to the images and the quality of the images and the -- how discretely you can see people in every image.

So in this image here, for example, it's very difficult for me to see the side-to-side movement, which normally is the best.

So if I'm looking at the -- at the door here and somebody is standing far away from me and I'm the camera, if somebody moves towards me just a little bit -- it's very difficult to perceive. But if somebody moves side to side, it's very easy to perceive.

But in this image, even though I'm looking this way, I don't even see the people, and that may be because of blurring, focus, panning, blurring, whatever it might be. And so the window and the range that I have here has to be opened up. So

I can move to another camera angle. It's true. And then I can look at it.

But there are -- there are other issues there. And one of them has to do with you have to be at the proper camera position.

Now, I don't know what method was used exactly by the different people; but, as you can imagine, if you have 12 images, the chances of it all lining up is actually pretty slim. You know, perfectly is very slim. And so in a photogrammetry project, what actually happens is -- some people say, "Well, if I have more pictures, it's going to get better." The inverse is true. As you add more pictures and you add more points, the chance of errors actually climbs. What happens is your confidence in that area, though, increases. And that's the difference.

So somewhere along the way, somewhere along the way some of the people doing this had to say, "Uhm, it doesn't line up exactly. Let me go back to that other image and tweak it a bit. Let me go to this other area and tweak it a bit." That's not what you're supposed to do. You're adjusting things to suit your needs.

In a true photogrammetry project, it tells you what the errors are and when you are wrong. The problem with this method is that you would not be able to detect any motion. We don't have the resolution of images to detect any kind of small

motion, at least not to the level that we're looking for in this particular case.

Can we see, you know, was the vehicle -- you know, did it move 6 feet? Yeah, we can see it moved 6 feet. Can we see it moved 4 inches or 3 inches? Very difficult to see.

Q. So let me loop back to -- can we switch back to the camera angle from square on?

A. Yes. Just a moment.

Q. Perhaps go to the frame of -- the frame of video that Mr. Terpstra believed corresponded with round five.

A. (Witness complies.)

Q. If we can zoom in on the three blocking vehicles.

All right. Now, as I recall, one of the -- one of the projects that you did earlier in this case was to show how much we could move one of the -- the position that Mr. Terpstra selected for a couple of these operators and have it still appear right to you. Is that correct?

A. Yes.

Q. Okay. And we saw during Mr. Terpstra's direct examination an image that showed that in order to accomplish that you had to take someone who Mr. Terpstra had fully -- standing up fully erect and make it into more of a crouching position?

A. That's correct.

Q. All right. Can we tell from this image what posture someone had?

A. No. And that was my -- my point earlier is that once we start placing these images in this area and start, you know, applying things like, well, his knee was bent here, his foot is up in the air, if we look over here, there's -- there's -- I mean, just look at the door here. That camera in the aircraft is moving. It's panning. So there's a number of things which are mutually at a disadvantage.

Q. How can you tell that the camera is panning?

A. Well, actually, if you watch the video, you can see it moving. It's very clear. It's not a mystery.

Q. No, but, I mean, you mentioned the door. What about the door?

A. What I'm suggesting here is that if you look at the corner of the door, it's not crisp. There's bleeding. It's moving up here. If we move on any of these images, for example, up here, there's blurring up here. Right? So now what's happening is we have stretched images. Right? We have blurring. We have pixels in location where they weren't. So we're giving the impression of people where they weren't. And so -- and this is an exercise where, you know, we're saying, well, we can kind of move in between that. But it's very difficult to tell from these images above or below. It's very difficult to tell, for example, here, like the foot is placed on the tip of its -- on the toes here. These kinds of things are very difficult to see and notice.

Q. Now, in fairness, the position of the defendant's toes doesn't particularly matter, does it?
A. No. I mean, the individual little defects, but what I'm trying to say is in the larger picture, just even the overall positions, it's difficult to tell. So, you know, how do we accommodate that? Do we accommodate that by putting in aggressive tolerance? No. We have to be careful. We have to be conservative, and we have to open up that window.
Q. Just to be clear, Mr. Liscio, when you performed your work to try to wiggle these people to show how much you might be able to wiggle it and not be able to tell in a given -- in a single given image, was that supposed to be your representation of what you think is the correct placement of these people?
A. No. That was strictly a demonstration just to say, look, you know, if we're saying that the people can be held to 3 inches or 6 inches, we can go beyond that. We can easily go beyond that and you can be fooled by looking at this particular image, easily.
Q. Now, if I could circle back to the question that we put aside a few minutes ago and switch to the vehicles.
A. Yes.
Q. Perhaps we don't even need to demonstrate this here. I'll let you decide that. But my question is the work that the government did with Mr. Terpstra's testimony to show that if we rotate Mr. Finicum's truck by a certain amount that was greater

than Mr. Terpstra's certainty range, which we now understand is his precision, you wiggled it by more than that and you couldn't see the difference in this image. Am I right so far?

A. Correct. Well, actually, what I was trying to point out is that another examiner could put it in that position and it could seem reasonable to them.

Q. All right. And the government's point in response to that is if we switch to another camera, another picture taken at a different time, we can see the difference?

A. Right.

Q. And so does -- so two questions. First question is does doing that kind -- does that critique depend on the truck being in the same position precisely in both images?

A. Well, not only in the same position, but it's -- you have -- you're making an assumption that there are no errors in your camera match. I think we've already seen yesterday that there can be gross errors here in the camera matches, and, you know, we can't just brush these off and omit them.

So as a result, what's the effect of four people leaving the vehicle? What is the effect of the movement in between? You know, I think -- I think -- I don't remember who was asked yesterday or the day before, you know, "Can you -- do you see any evidence of the vehicle moving?" Well, of course, we don't see any evidence. We don't have images that have any quality. Nobody was monitoring these things.

So, unfortunately -- well, let me say this: If it was possible to use a fully photogrammetric analysis with proper -- you know, we had decent images, the analysis would tell you that there's a problem between these images. And, unfortunately, when -- when you are doing camera matching, there's nothing to tell you that something has changed, and so you could be under a grave misapprehension about what is in the images.

Q. I would like to unpack what you just said, actually. What we're talking about is if you're doing a true photogrammetry analysis, the software or the analysis will tell you how big your error is. What do you mean by that?

A. Well, it has to do with the reporting which is in the photogrammetry. So there's something we typically refer to as residuals. The simple way to describe that is the software believes -- the software calculates that you've entered all these points and locations, and it has a solution. And it says, "Okay, I know where all these points are in 3D space." If one of those points is marked or you tell it that, "Well, in this other image it's here" and it says, "Well, the calculation, based on all the other images, says it's here," it says you have an issue. There's residuals here. There's a leftover -- there's a number of pixels in between here in a 3D distance which is giving you a problem.

You don't have that benefit when you're using camera

match -- manual camera matching, and so, as a result, you have to take other measures to be careful and not overly aggressive in this -- in this analysis.

Q. Is it fair to say, then, that Mr. Terpstra's analysis -- camera match -- anyone doing camera matching has no idea how far off they are from the right answer?

A. Unless you have a highly controlled scenario where you can go back and re-create, test, and somehow validate what you're doing, and that's what scientific method is. You have to be very careful about making those types of claims because we just don't know.

Q. Mr. Liscio, are you familiar with camera matching as a technique where objects are in contact with a scanned surface? By that, I mean, put simply, touching the ground.

A. Yes. Yes.

Q. And we've discussed some studies earlier this week that describe -- describe this as a method for object placement in a camera matching process, putting objects that touch the ground?

A. Correct.

Q. Are you familiar with what Mr. Terpstra has done here in placing objects, such as Mr. Finicum's truck, in a way that they're not in contact with the ground?

A. Yes.

Q. What is wrong with that?

A. So the issue goes back to the subjective nature of placing

something which is not on a surface. And if, for example, it was possible to, you know, take a crane, remove Mr. Finicum's vehicle, and then scan the entire area, we would have a very good record of the snow and the locations where everything was. And so when we do camera matching or we put it back in place virtually, we know where the surface is, where it lies.

But if there was -- I don't know how much snow there was -- a considerable amount of snow. If at the time that the laser scanning was done, you know, it's -- it's changed, no matter how much -- if that surface has changed, which I believe it very clearly did, you can't do this intersection on a surface. So, again, it becomes even more subjective.

Q. Do you have any experience in coursework or training you've received on the use of camera matching that cautions against placement of objects in a way where they don't touch the ground?

A. Yes. So most -- it's sort of a general rule in photogrammetry, where it's a simple principle, and that is if you're not on the surface, okay, you're introducing even greater subjectivity, and it is much more complicated to tell where it is in space.

Q. If you had to explain the mathematics behind why the process becomes more subjective in this scenario, is that something that you would do, or is that something you would defer to someone else?

A. I could -- I could sort of demonstrate it graphically, but if somebody had to do all the mathematics and the algebra, I would defer to someone else.

Q. Anyone in particular?

A. Maybe Mr. Mugnier.

Q. Do you know Mr. Mugnier?

A. We've met only very recently. Sorry. I've known Mr. Mugnier only on -- by the phone for several years now, but we only had the opportunity to meet a few weeks -- or I don't remember right now if it was a few weeks ago, or so, yeah.

Q. Mr. Liscio, did you compare the total station data that was taken in this case with the camera match results that Mr. Terpstra has provided?

A. Yes, I did.

Q. All right. I'll give you a moment to pull that up.

A. Thank you. Yeah.

Q. Let me know when you have that up and when you're ready to start, and I'll ask you a question.

A. Sure. Okay.

Q. All right. Tell us what we're looking at, please.

A. Okay. What we have here is a file provided to me by Mr. Terpstra. This is a combination of what I believe is three things. Excuse me. Actually, multiple things. It is the -- we have the underlying laser scanner data that was used for the environment.

Q. Just to be clear, this is the point cloud data that Mr. Terpstra collected in November of 2017?
A. That's correct.
Q. Okay.
A. Then we have the -- I believe it's the total station data that Mr. Terpstra did.
Q. Is that the -- Mr. Terpstra did or Mr. Turpen did?
A. Well, Mr. Terpstra. I was referring to Mr. Terpstra. His total station survey.
Q. Okay.
A. And we have the total station data overlaid from Mr. Turpen.
Q. And just so I don't have to put a dollar in the Terpstra/Turpen jar, I'm going to refer to him as "Deputy Turpen." All right?
A. Deputy Turpen. Okay. Great.

So I've overlaid -- well, I haven't overlaid. I'm just opening the file that was provided to me. I haven't done anything to this file. All I'm doing is inspecting this.

And so what I'll -- what I'll just point out to you are a few things right off the bat. So if we look at the total -- this is what I believe is the total station survey and the scan data, and you can see that there is some mismatch here between the total station and the scan data.

Q. Now, let me just be clear about what colors mean what

here. If you can mouse back over the lane markings.
A. Yeah. So I've got them highlighted now. As I mouse over them, it highlights. I believe this is the total station data from Kineticorp.
Q. Just to be clear, this is -- the total station data is the yellow lines?
A. Correct. Actually, when I move off them, they actually turn a dark color.
Q. I see. They go from yellow to black?
A. Yes. It's just because I have them highlighted. I hover over them.
Q. And the yellow lines that we can still see there that appear as little points, a pointillism version of these lines, if you will, is that from Mr. Terpstra's point cloud data?
A. Yes. Those little dots are from the point cloud data.
Q. And the yellow lines are from Mr. Terpstra's 2017 total station data?
A. Yes, as I'm highlighting them now.
Q. Okay.
A. So what I want you to note here is that right from -- well, all I would like to point out is if you look at the alignment between these lines and the stripes that are on the scan data, we're starting at a point of some misalignment. And if you measure this distance here in this area, it ends up being 2 inches. Okay?

On top of that -- let me do something here to make it a little bit more tangible. I'm going to move in and just move around here, and so I'm going to get rid of -- that's the police survey. Let me get rid of the people for a moment.

Q. While you're setting that up, I'll just ask you a question.

THE COURT: Do not do that. He can't do two things at once. You say, "While you're doing that, I'll ask you a question." That doesn't mesh. Just wait until he gets through.

MR. FRANCIS: Fair enough, Your Honor. Thank you.

THE WITNESS: Okay. What I've done here now is I've increased the point size of the scan data, so it may be a little bit more helpful to see. But what I want you to note is -- oh, boy. Okay. It needs to update here and refresh. It's not doing so good. Let me go from a top-down view. Maybe that's better. Okay. So if I zoom in here, okay, maybe -- I hope you can see this. Yeah, I think you can see this. What I'll do is these lines here -- like this, sort of, "T", that appears to be a survey point. I believe it's from Mr. Terpstra's survey, and you can see the colored paint underneath just on the point. There's a little strip here that you can kind of see the scan data. All the points -- let me shut it off. Maybe it will be clearer. So here, can you see now? There's, like, a little "T" here of colored points?

Okay.

Q. We're talking about this right here?

A. Oh, great. Thank you very much.

Q. You can do that, too, by the way. Your screen has a touchscreen as well.

A. I haven't used it before, so can I test it? If I do something like that? Okay. If I want to erase it?

Q. That's an excellent point. That may be a little harder for you to do up there.

So up in the corner here -- hold on. Let me steer for a second. Up in the corner here, there's a button, if you push it, then there's a clear button in the bottom left.

A. Oh, okay.

Q. That's an eraser, but don't -- don't worry about it.

A. If you can, just erase it all.

I'll let you do that. I don't want to mess with it. I've got enough going on.

So, anyway, the point here that I'm trying to make is there are three things that I want to point out. This "T" here that you've pointed out, there's this circle here, and this circle is from Mr. Turpen's survey. Deputy Turpen's survey. And I expect that that is supposed to be at the same location where the tires were. You can see that it doesn't align with the "T." And when we go to the paint markings, it's also in a slightly different position.

And so, again, I just want to point out that starting right from ground zero, the information that's being provided to us is not even overlapping within an inch.

Okay. So if -- if we don't have that as our ground truth, then it's very difficult to extrapolate from that and say, well, we're doing better and not worse. It's sort of a difficult argument to make.

I wanted to also show the Finicum vehicle, but to do that, I was hoping that I could give a demonstration using the box, the famous --

THE COURT: Sure.

THE WITNESS: Okay. And then for speaking, do I need to just speak loudly, or can I be -- okay.

THE COURT: Hand him the box.

THE WITNESS: Can I also have the rod that's there?

MR. FRANCIS: Thank you, Ms. Oakley.

THE WITNESS: Okay. This might be a little difficult to do.

THE COURT: That's all right. I can hear you.

THE WITNESS: Okay. I'll try to do it sitting down because it may be just as clear.

THE COURT: Either way is fine.

THE WITNESS: Okay. If we assume that this is Mr. Finicum's vehicle, and let's say the front of the vehicle is facing you, Your Honor, and the back is facing me, we know

that, as a starting point, it was tilted. And I'm not doing this to any kind of accuracy. It's just a demonstration.

So we know that at the start it was tilted over this way. And based on -- I think Ms. Dickerson said it earlier this week, that it's reasonable to assume, based on everything that we've heard, that the truck is -- is settling this way.

There are a number of things going on there. I can discuss some of it and what my opinions are there, but I'll maybe just leave it at that for now.

It starts in a position where it's tilted this way, and in 1:00 in the morning, or whatever, the truck, say, settles down, and then it's surveyed.

So the survey uses a pole, a prism pole, and the operator has to -- if I go like this, has to walk up to the vehicle, and let's say this is the rear bumper. He puts it against the rear bumper, and he takes a measurement. He goes to the front bumper, and he takes a measurement.

If we start from the beginning, though -- this is when it's settled. If we go back to this position and we were to survey the Finicum vehicle, in the camera match it should be to the right of, east of the survey points. So this is where it started.

So if we were to survey it here somehow when it was first in the snow and then we rotate it back and then we take measurements of the front and back, the Finicum vehicle has to

be to the right of the survey points.

I hope that's clear. The Finicum vehicle to the right of the survey points.

BY MR. FRANCIS: (Continuing)

Q. Mr. Liscio?

A. Yes.

Q. Have you had an opportunity to compare the total station data collected by Deputy Turpen over nine hours after shot five was fired with the camera match results from Mr. Terpstra and determine whether it is consistent with the government's theory that the Finicum truck only shifted in a -- by rolling in the way that you just demonstrated for the Court?

A. Yes. That's what I was getting to.

Q. Please proceed.

A. Okay. So I just want to -- so I just want you to remember Mr. Finicum's vehicle has to be to the right of the survey points. That is the center of the survey point, and it's about 6 or 7 inches off of the bumper here. It's in the opposite direction.

If I go to the back, you'll see that the survey points are in the opposite direction by a few inches. And you could ask yourself, "Are these errors? Are these -- did something happen?"

Well, actually, there are two more points. This position here is actually inside the bumper, which is not possible.

Okay? This position here is also inside the bumper, which is not possible, which means that a -- a couple of things. Those four points are consistently telling us something about the vehicle, and that is, as I demonstrated before, Mr. Finicum's vehicle should be over those points, to the right of those points, not to the left.

If this is the starting point and the vehicle goes back, as it's shown here by Mr. Terpstra's camera match, it's going to move even farther from where those points are surveyed.

So the suggestion, and I think we all agreed, is that that vehicle is not going to slide 8 inches, or whatever, side to side, but that is what is being suggested, and it's completely illogical to everything that we've said. And so --

Q. And -- sorry.

A. -- based on what I'm seeing here, the -- the difference between Mr. Terpstra's camera match and the total station makes no sense, and they are irreconcilable.

So all we can say about this data is that there's a mistake, a grave mistake, and to me what it says is that because we've used a very subjective method, even in 12 images, when it may appear that everything fits perfectly, you can still be under a very grave misapprehension and be wrong.

Q. And is this discrepancy that you've pointed out, is that consistent with the government's theory of how -- of the limited way that this truck supposedly settled over the course

of nine or more hours?

A. No, it's not.

MR. FRANCIS: All right. If we could bring up Exhibit 8-2 from yesterday, please. I'm going to switch the screen over, Ms. Oakley.

BY MR. FRANCIS: (Continuing)

Q. All right. Mr. Liscio, on the screen in front of you you'll see Exhibit 8-2. This is the Coleman experiment or the study documenting the Coleman experiment that we were discussing yesterday and a little bit this morning.

Are you familiar with this paper?

A. Yes, I am.

Q. My first question for you about this paper is whether you can tell me some of the differences between the photos that were analyzed for this experiment and the images that we have in this case.

A. Well, I think it's clear to everybody. These are high-resolution images taken from some form of digital camera. These are -- these are from a stationary platform, somewhat stationary, that we don't get, you know, camera blurring or panning effects. We have good contrast. We have good color. If we look at, you know, obviously, the other images that we have, as much as we would like --

Q. We can flip to the next page.

A. Okay. Sure. Yeah, we have -- I mean, what can I say

other than I think you can see it for yourself. I don't want to -- you know, go any further.

You can see that they're very clear images. They're close range. They're high resolution. They're not what we're dealing with in this case.

Q. Not blurry images taken from two miles away?

A. Correct.

MR. FRANCIS: Can we take a look at the chart on page 19, please. All right. If we can zoom in on the camera matching portions of this chart. The top two. All right. Perfect.

BY MR. FRANCIS: (Continuing)

Q. All right. Now, in our case, would we expect to see errors greater than these amounts, smaller than these amounts, or the same, based on what you've just said about the quality of the image difference?

A. I have to stand by my previous statement, and that is it's very difficult to extrapolate from one test to another. So it's sort of a difficult position to now have me say that, hey, you know, based on this, we can do something else.

I think what we can say here with these numbers is that if these -- if these are the kinds of results that we are getting when we are using close-range photogrammetry and in my own experience in some of the papers that we have done, even at close ranges, doing suspect height analysis, and things like

that, and when the conditions are controlled and known we're still getting an inch in very good conditions.

So I would say that based on and because of the evidence and taking the evidence for what it is, the quality of the images and everything else, the expectation is the results are not going to be in your favor.

Q. Would it be appropriate to assume that the -- just to be clear about what we're seeing here, these are the -- this is how many centimeters off from the right answer camera matching -- camera matching is saying it's one place, and the right answer is this number of centimeters off. Is that your understanding of this chart?

A. That's correct.

Q. Now, would it be appropriate to assume for this case, for these images, for Mr. Terpstra's camera matching project, that the correct number for all of these vehicles and people is zero?

A. Are you asking?

Q. I'm asking you that.

A. Is the accuracy zero?

Q. Would it be appropriate to assume that the accuracy is zero for this case?

A. No. Of course not. No.

Q. All right. Yesterday Mr. Maloney threw some objects on the floor and was asking Mr. Terpstra to explain why we might

get more accurate results from images that were shot from overhead as compared with if an image is shot from down low.

Do you remember that testimony?

A. I do.

Q. What's your reaction to that testimony?

A. In principle, all things being equal, that's a fair statement. So if I'm at 30 feet from a vehicle on the -- you know, on the ground, and then I'm -- you know, I climb up a ladder, or something, and all of a sudden I'm 30 feet above the vehicle, pointing down, I could say we could accurately -- it's a better position to be in to locate that -- to locate that vehicle.

But to suggest that having blurry images at 11,000 feet away and not being even directly overhead, but further out, and having all these other factors that we've highlighted is somehow beneficial versus a close-range high-resolution photo on the ground, that -- that doesn't -- that doesn't compute. It doesn't make any sense.

Q. Does the fact that we're two miles away with a blurry image somehow cancel out the fact that -- or is it -- is that somehow canceled out by the fact that these images were taken from an airplane?

A. Well, they're -- they're detrimental to your analysis. That's the bottom line.

Q. Do you agree with Mr. Terpstra's statement yesterday that

using camera matching photogrammetry in a situation like this is a unique scenario that hasn't been studied before?

A. As -- as I said before, photogrammetry, by its very nature, doesn't -- does not have the benefit of being, like, calibrated like a manufacturer's instrument or something. So when we find ourself in a situation where the variables are unlike what we're typically used to, then we have an issue, and it becomes a unique scenario for which we do not have any empirical, any peer-reviewed studies, or anything like that, to lean on.

Q. Going back to the image in front of you, and I direct your attention to the top portion of the chart, the portion of the chart that's referring to camera matching where lens distortion correction was not applied. Are there a number of these errors that are around or above 15 centimeters?

A. Yes.

Q. And, again, that means that the camera matching is saying that an object is in one location, but, in reality, it's, for example, 15 centimeters away?

A. A pixel, a marked location is saying that the -- the estimated 3D position is not in the correct location.

Q. By the amount shown on this -- this chart?

A. Correct.

Q. All right. Let me translate -- let me see if we can translate that into the cone, the plus or minus that we've all

been talking about here. Do you agree with Mr. Terpstra's comment yesterday that the position of Mr. Finicum's truck is critical to the placement of the trajectory rod?

A. Absolutely.

Q. How much would the horizontal azimuth angle change if you were to rotate the truck such as the back -- in a way that the back wheel shifted by 15 centimeters?

A. Well, actually, I did the calculation, so it ends up being about 7 degrees.

Q. And, again, 15 centimeters -- there are a number of data points in this chart, in the top portion of this chart, that we can see, that are above 15 centimeters; right?

A. Correct. But, again, in fairness, what you're asking for may not correlate exactly to the vehicle.

Q. Of course.

A. Okay.

Q. At -- for example, that's what I'm asking.

A. Yes.

Q. 15 centimeters, how many pixels is that for the overhead FBI video?

A. All right. Yeah, it's something I didn't discuss. But one very quick calculation that can be done, which I didn't see done in this case, is to look at the -- let's say an object of known dimensions. So, for example, maybe the back of the vehicle or distance between road lines or something like that,

and when you take that distance and then divide it by -- or divide by the number of pixels, you can get how many inches per pixel or how many pixels per inch. So you can choose whichever metric you'd like. It's not an actual -- it's like -- how can I say this? The quick and dirty. You know, it's roughly something like this. This is kind of what I'm working with.

When you do that in -- at least in the -- oops -- in the one image which -- the aerial image for shot five that was being used, it ends up being about one and a half inches per pixel, which means that we cannot do better than one and a half inches on every pixel. And if there's blurring or if there's other things in that one image, it's very difficult to judge.

So if we're off by four pixels, then we're getting up to about six -- six inches or so.

Q. Is that -- is that -- my metric calculator today is broken.

A. Sorry. It ends up being about 15 centimeters.

Q. So if you can show us on your screen -- I've given you control back. If you could show us the image that you're describing where one pixel is equivalent to an inch and a half, the -- the shot from the FBI camera.

A. Oh, okay, sorry. Oh, I have to load this back up.

Q. That's fine. Take your time, please.

THE COURT: Well, you can take your time, but we have been going an hour and a half.

MR. FRANCIS: Your Honor, I only have a few more questions for him.

THE COURT: Go ahead.

BY MR. FRANCIS: (Continuing)

Q. Okay. All right. So is this the image that you -- if you can zoom out to a hundred percent. Is this the image that you're saying that one pixel is an inch and a half?

A. That's correct.

Q. And so we all -- am I understanding you correctly that we only have to be off by four pixels in this image for the rotation of Mr. Finicum's truck and the plus or minus 5 degrees that we've all been working with now gets another 7 degrees added onto it?

A. If that were to be true, yes.

Q. If we were to be off by --

A. If you were off 7 degrees, that would be true.

Q. Finally, Mr. Liscio, we all heard yesterday that Mr. Terpstra used camera matching on the wrong image. But even if he went back and used camera matching on the right image, would that make camera matching itself any less subjective?

A. Absolutely not. We're stuck in the exact same place, and, as I mentioned before, the -- the difference between the total station and the camera match solution suggests that we've somehow suspended the laws of physics and going in the other way, and they're -- like I said, they're irreconcilable at this

point. I don't know what you can do to fix that.
Q. If Mr. Terpstra used camera matching on the right image, would that make his result any more reliable?
A. No.
Q. Would it tell us how accurate his answer is, how far away it is from the right answer?
A. He never provided accuracy to begin with, so we wouldn't have that.
Q. And would going back and performing camera matching on the right image this time fix any of the problems that you and I have discussed this morning?
A. No.

MR. FRANCIS: I have no further questions.

THE COURT: We'll take our morning recess. Fifteen minutes.

We're in recess.

(Recess taken.)

THE COURT: Have a seat, everybody.

Counsel?

Oh, wait. Everybody here? Okay.

Go ahead.

MR. MALONEY: Thank you, Your Honor.

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CROSS-EXAMINATION

BY MR. MALONEY:

Q. My name is Paul Maloney. Have we ever met, sir?

A. I don't think so.

Q. You've been present throughout most of this proceeding?

A. That's correct.

Q. Have you been here the whole time?

A. Yes. I believe so.

Q. Okay. It's been a long week.

A. Yeah.

Q. If at any point any of my questions confuse you, that's on me. Please ask me to correct them. I'm not trying to trick you or otherwise. We're after the truth here. Okay?

A. Sure. Thank you.

Q. You were hired to conduct a 3D -- a 3D analysis in this case?

A. I was hired to evaluate Mr. Terpstra's report. So if you are calling that a 3D analysis, then that would be consistent.

Q. Okay. Did you review the -- all the materials that were provided to the defense in this case?

A. So I had a massive hard drive of stuff, and so I did not go through every single piece, because it was obviously too much, but I went through what I thought was the pertinent information that related to my efforts.

Q. And you listed the materials reviewed in your report?

A. Yes.
Q. And are those the only materials that you reviewed, or were there additional materials that you reviewed but didn't find them important enough to list in your report?
A. Oh, yeah. Correct. There are some things that may have even come up after that. But I think for the report and at the time I had created a list, and, in varying amounts, some things were more important than others, yeah.
Q. You had access to the full discovery?
A. I -- like I said, if the hard drive that I was sent was the full discovery, then that's what I -- yeah. Then I would say, yes, I hope so.
Q. You had access to the scene?
A. No. I did not go to the scene, if that's what you're asking.
Q. But you could have; right?
A. Yeah, I could have.
Q. And the government has -- or were you aware that the government has made the Finicum truck available to the defense for inspection or testing as they -- as they needed?
A. No, I wasn't aware of that.
Q. Okay. Would it assist you in your evaluation and analysis in this case to review that truck?
A. Based on what I did, it would not have really helped. I'm not doing trajectory work. I'm not doing a lot of -- a lot of

else that is sort of more detailed.

So other than being familiar with it, the materials that were provided to me from Mr. Terpstra's evaluation were sufficient.

Q. So you did not visit the scene. You did not visit -- you did not inspect the truck that was under investigation in this case?

A. That's correct. And if I felt that I needed to do it, I probably would have asked, but it was -- it really was -- it wouldn't have added a lot of benefit, I feel.

Q. Did you bring your full case file with you today?

A. I believe that I have it. I would have to just organize a few things, but I would be happy to make that available to you.

Q. Thank you, sir.

And I think you've described the scope of the work that you were retained to perform, and that was just an evaluation of Mr. Terpstra's work?

A. I was asked to consult in sort of more broad terms, like asked questions about the vehicle and -- in the snow and things like that. And possibly because of my engineering background, there were other questions posed to me, but the -- but the central focus was on Mr. Terpstra's report.

Q. So you were hired to consult and help the lawyers learn more about the science that you are trained in?

A. Correct. Laser scanning, photogrammetry, the hand

scanners, total stations, all those things, and how they come together.

Q. And you're familiar with the scientific method?

A. Yes, I am.

Q. Did you apply it to your work in this case?

A. No, I did not.

Q. You've read Mr. Terpstra's report?

A. I have.

Q. And you heard him summarize the steps that he took to build his model?

A. Yes. You mean from his testimony?

Q. Yes, sir.

A. Yes. Yes.

Q. Did you do any of those steps that Mr. Terpstra did?

A. I did not do any camera matching, no.

Q. Did you -- but you read the materials?

A. Correct.

Q. Like he said he did.

You didn't do a scene inspection. You didn't do a site inspection.

Did you do any 3D scans or surveys?

A. No. They were provided to me.

Q. So you just looked at his work?

A. That's correct.

Q. Did you do a frame-by-frame analysis of the video

involved?
A. I did review the images, looking at them frame by frame, but not from the perspective of trying to identify which shot or anything like that.
Q. Did you conduct a detailed study of the positioning and alignment of the vehicles?
A. In review of Mr. Terpstra's work, yes, if that's what you mean.
Q. Did you perform a detailed study of the people present in the videos?
A. Again, yes.
Q. And you testified that you did not perform any camera match photogrammetry?
A. No, I did not do any of my own.
Q. Have you done that before?
A. I have.
Q. You've used camera match photogrammetry?
A. I -- okay. Just to define it, as it was done in this case, I did it only as a test to compare to other methods. In my own work, I can say that I have never used the method which was employed here in the same manner.
Q. Okay. Let me see if we can kind of thin slice that a little bit more.
A. Sure. Sure.
Q. Did you -- have you ever used manual camera match

photogrammetry?

A. Never for a case, no.

Q. You have used it before?

A. Yes. I'm familiar with it.

Q. And give us an idea the context in which you have used manual camera match photogrammetry.

A. When I first began working with photogrammetry, like analytical photogrammetry, I was interested in what other things were out there. So I learned how to do it in 2006 or somewhere around that time. I don't remember exactly. And I made some comparisons of the method and just trying to understand what -- what it was, how it worked, who was using it.

And so after I realized what it was -- that's not my starting point. Let's put it that way. In any case, I always try to go from the top of the list and work my way down and see where I end up, and I haven't had to do anything like that that's fully manual.

Q. Would you agree that there are cases where that's the only method available?

A. Absolutely.

Q. And when performing camera match photogrammetry, what's more reliable in your -- in your judgment, doing a manual camera match using one photo or doing a manual camera match using more than one photo?

A. So in -- in principle, and again, all things being equal -- all things being equal with crisp cameras and having good control and all these sorts of things, having two images is beneficial. No doubt about it. But we have to qualify a single-image project can be more accurate than two, you know, poor image -- more images that are provided that are blurred, that are out of focus, that are at nighttime, it's raining, it's contrast, and sometimes we get those kinds of things.

So you have to put it in perspective. There's -- all things being equal, my answer is, yes; if they are not equal and the conditions are different, then -- then they don't equate.

Q. So one high-quality photograph could be better than multiple low-quality photographs?

A. Yeah. That scenario could definitely exist.

Q. And you would agree with me, sir, as a person who works forensic cases, it's important to work with the evidence you have?

A. It's important to evaluate the evidence you have. And once you make the evaluation, it's important to make a decision or at least evaluate what that evidence can provide you. And it's an interesting discussion, and I have been talking too long, I think, but the -- the -- I had a conversation a few weeks ago -- two weeks ago with a woman at the RCMP in Canada. And to put this in perspective, she asked me about if we do

blind studies for -- in my work, and what she said was, for example, with latent prints, when they do fingerprints, when they're doing proficiency testing, when they give good prints to the examiners, they do incredible. They do very well. And she says, "We don't make mistakes." But the problem is when they deal with real evidence from crime scenes, it drops down, and then they start making mistakes. So, as a result, we need to take additional measures to ensure that we -- we don't have problems.

So that correlates to what we're doing here as well.

Q. So it is a human endeavor?

A. Manual camera matching? I'm sorry.

Q. I'm sorry, sir. In the general forensic sciences, it's a human endeavor?

A. I'm not sure what that means.

Q. Humans are involved?

A. Yes. We're people. We're somehow involved. Absolutely.

Q. And people are not perfect?

A. No, but there are some methods which are more scientific than others, and there are some processes which are much more objective than others. And so if you're speaking in generalities, for example, DNA is like the golden standard. I think most people look at that as the top, and most of the other disciplines in forensic science have been trying to mimic what the people in the DNA community have been doing.

Q. The -- there are no absolutes in science. Would you agree or disagree with that statement?
A. That's correct.
Q. You build 3D models for your own work?
A. I do.
Q. And did you have all the raw materials necessary to build your own 3D model based on the data collected in this case?
A. The only piece that I was missing was one file that I don't know either because it was delivered or it had become corrupt; but, in general, in answer to your question, I would say, yes, I would have had enough information to reconstruct the vehicle models.
Q. Did you build such a model?
A. No, I did not.
Q. Is it routine and accepted within the world and community of 3D scene reconstructionists to rely on the work of other experts when building a 3D model?
A. Do you mean you need to rely on other people when doing a 3D reconstruction?
Q. Yes, sir.
A. Okay. In that case, it's very common, yes.
Q. And some of those people have specific training, skill, or knowledge that you don't have, and that's why you would rely on them?
A. That's -- that's completely possible, yes.

Q. Are there peer-reviewed studies and publications that validate the procedures and methodologies used in building a 3D scene reconstruction?

A. Building a 3D scene reconstruction? Offhand, I can only say that there are some studies that deal with using 3D models for things like suspect height analysis, and that is a type of reconstruction in collision investigation, in -- in those other areas.

So to answer your question, in part, yes; but if you're asking me was there a methodology or peer-reviewed paper for what Mr. Terpstra did here today, I honestly can't answer that.

Q. And you read Mr. Terpstra's report?

A. Yes.

Q. Are you familiar with the studies he has cited in his report?

A. I went through many of them. Some of them in greater or less detail.

Q. And do you accept those as scientific journals and authorities that you rely upon in your field of study?

A. I have become more critical with the more gray hairs I have on my head here. So just because it's a published study, I'm much more critical nowadays than I have been in the past. So we need to look at each of these studies to see how scientific they were.

And let me give you an example. It's very common, for

example, at the university, for students to do little validation studies and things like that. It depends on what you're asking and what you want to get out of a study. So in many of those studies that were done, the -- the -- what they're asking is, "Does this work?" That's really what they're asking. "Does this method work, and what kind of errors can we get?" So in that regard, yes, they may be valuable.

But a true scientific paper has statistics involved. There's comparisons and there's blind studies. And blind studies is being pushed a lot these days, and you don't see a lot of that in the papers.

Q. What about the papers listed in Mr. Terpstra's report?

A. I -- I would say the majority of them are not blind. They were mostly the examiners, you know, trying to prove that their method works.

Q. And you've stated that you rely on software to assist you in performing 3D camera matches or -- let's start generally. General category, 3D scene reconstruction.

A. Yes. So, for example, I would use -- what I do is everything is 3D. And if it's 3D, you're using software, yes.

Q. And are you familiar with 3D Studio Max?

A. Yes, I am.

Q. And the other applications and softwares listed in Mr. Terpstra's report?

A. Many of the software. The AutoCAD, Rhino, CloudCompare, Pix4D, PhotoModeler, yes.
Q. Are all those applications commercially available and generally accepted within the community of 3D scene reconstructionists like yourself?
A. I would say they are used for sure in forensics, yes. I would say people use those tools in forensics. I would say they're accepted, but it obviously depends on what you're doing.
Q. Now, do you do camera matching in your work?
A. What I do -- what I attempt to do almost every time is actually called a resection. Maybe nobody has talked about it here, but a camera resection is actually what is done in a photogrammetry software package, and so that is a type of analytical camera matching, let's say.
Q. Would you agree that a 3D model is best viewed in the virtual environment using a computer screen?
A. Yes. Unless some people would -- may argue with you that virtual reality now is probably better; but, yeah, a computer screen is typically what everyone is going to use.
Q. Do you find that certain aspects of the model or qualities of the model are lost when the model is reduced to, say, a printed page?
A. Just so I'm clear, you say "the model." Do you mean, like, the reconstruction? A model, to me, means, like, the

truck or the bipeds or whatever.

Q. Fair enough. The reconstruction.

A. Gotcha. So you mean, like, if you print it out on a paper and then show somebody?

Q. Sure. If you did a screen grab and printed that off.

A. Yeah. Generally, I would say, depending on what you're showing, yeah, you don't have the ability to move around and all that other stuff, yeah.

Q. What other qualities could be lost?

A. The perspective, obviously. You're locked into one perspective. You know, I guess if you print it out on your printer from 1998, you're going to lose resolution or you'll lose quality of the image.

Q. I have a printer from 1998, and that is a warhorse, and it is still going strong.

A. Okay.

Q. But what's going on? Why -- why are we bagging on the 1998 printer? Why is that no good?

A. Well, all I mean is that obviously depending on what you wish to show, you know, you print it out accordingly. That's all.

I mean, if you want to show the distance between two objects, then just zoom in and show the distance between two objects. So you still get the message across.

I'm not sure what you are trying to get at.

Q. Do you have stereoscope in your work?
A. I do.
Q. And do you use it to test your 3D models?
A. No, I don't.
Q. Why?
A. I don't use it personally for a couple of reasons. And if you mean, like, why I don't use it for demonstrations and such, one is that I only recently got it; and the second one is that some people that are new with it maybe -- may not understand how it works.

But the bottom line is that, for me, I -- I haven't -- I haven't seen a need to use it for validation at the moment.

Q. Have you -- are there any published studies that discuss, validate, the use of a 3D -- or use of a stereoscope to evaluate the accuracy and precision of a 3D model?
A. So using a stereoscope is, in fact, how photographs --
Q. Please answer my question.
A. And I'm trying to remember. There may be a paper. There may be a paper out there. And I could be wrong, but I remember a paper talking about validating an animation, but it escapes me now. But I guess the answer I would have to say right now is no. I don't -- I can't recall offhand if that is true or not.
Q. In your report, you call out the use of a -- we'll call this the Brittney Doherty photo. Are you familiar with the

photo I'm referring to?
A. Please refresh my memory.
Q. Sure. This is the photograph that was taken from the rear of the roadblock, looking towards the scene; from the north side, looking south.
Do you recall that photograph in your review?
A. If it's the one I'm thinking about, it has a tree in front of the vehicle, or a bush, or something --
Q. Yes, sir.
A. -- in front of the Finicum vehicle?
Q. Yes, sir.
A. Okay.
Q. Do you recall that?
A. Yeah, I do.
Q. Do you recall calling it out in your report?
A. If I recall correctly, the issues that would have been raised with that particular photograph would have been that it was occluded -- in the snow and occluded partially and also the fact that it is far away, so it doesn't make up a very large portion of the photograph.
Q. But there are parts of that that are common to the other photos; right?
A. You mean things that are visible; right?
Q. Yeah.
A. Yeah, sure.

Q. Sure. There were mature trees and tree trunks visible?
A. There were.
Q. The unique features of that vegetation?
A. You have to be very careful with vegetation. And I realize that in some of the studies people will say to use tree trunks; but, in fact, most photogrammetry people will tell you to avoid vegetation, branches, and that sort of thing. And you can imagine why, if it's snowing, what happens to all the branches and such. They move. They break. They do whatever. So foliage and vegetation is actually a very poor indicator for referencing.
Q. But the roadway is there?
A. The roadway is there. One of the issues with the roadway is that it does not make up a very large portion of the photograph, meaning that in some of the images, it may only make up 20 percent or 25 percent of the roadway. The rest of the image is snow and trees.
Q. The roadblocked vehicles are visible, are they not?
A. They are.
Q. And the photo was taken in the daytime; correct?
A. Yes.
Q. You call out that photo specifically also.
THE COURT: Why don't we put it up on the screen?
THE WITNESS: I may have it here if you want. Let me see.

Do you mean this one?

MR. MALONEY: Yes, sir.

THE COURT: Thank you.

BY MR. MALONEY: (Continuing)

Q. You call out the unknown timing of that video. This was actually a screen capture from a video; right?

A. From a video, yeah.

Q. Is it daytime or nighttime during that photo?

A. It's daytime.

Q. And do you recall, sir, what time the shooting took place?

A. 4:00. I remember the time code was, like, 30 something, but it's off by three hours or something like that. So help me out here. 4:00, 4:30, something like that. 4:33, 4:34.

Q. Do you recall what time the sunset was?

A. It may have been, like, a half hour later or something like that. I don't remember exactly.

Q. So for the purposes -- we know that this photograph was taken sometime after the shooting and before nightfall; right?

A. Correct.

Q. Are you familiar with what metadata is?

A. I am.

Q. Was the metadata provided for all of the photographs that you received in this case?

A. For some of them, yes.

Q. Did you look at the metadata for this case -- for this

photograph?
A. In some cases -- this one I can actually bring it up for you. This is what I have in this particular image.
Q. What is there -- is there a timestamp for that photograph embedded in the metadata?
A. Yes. It says 2:36:30.
MR. FRANCIS: We'll stipulate that this image was taken within ten minutes of round five.
THE WITNESS: So the date and time here shows November 15, 2017, at 14:36:30.
BY MR. MALONEY: (Continuing)
Q. Now, shot number five, can you bring up the photo associated with that?
A. I can.
Q. And you were present when Mr. Piazza identified this as his sync, or is this the photograph that Mr. Terpstra used?
A. Yeah. So this is the one that was in the camera match folder that Mr. Terpstra provided to me. And so, yeah, this is the one that I believe was the one that Mr. Terpstra used and at the time whatever sync was, yeah, it wasn't important to me, because I'm just analyzing the other images here.
Q. That's the -- that's .3 seconds before shot five was fired, by the audio. Agree?
A. Again, I didn't do my own analysis, but I'll say yes.
Q. And would you agree that in your work with the Royal

Canadian Police, that if there was a bank robbery and you had a photograph of the bank robber .3 seconds before the bank robbery, would that be an important photograph to the investigation?

A. Your question doesn't compute with me. It's so vague that I don't understand what you're asking. Are you asking me -- you're looking at the bank robber .3 seconds before and you want to do a suspect height analysis? Are you asking me -- what are you asking?

Q. Sure. We'll assume that.

A. Yeah, it is important because you're looking at body position when you are doing suspect height analysis. So you need to find the proper frame in which you can analyze. If you go .3 seconds later, the body position could be completely different and unusable for your analysis.

Q. And multiple photos of our hypothetical bank robbery or screen captures, even better, from a video, would be informative to that analysis?

A. If you're at a single camera, there's really no benefit. You're stuck with the same thing. If you had six cameras in the room all focused on him, then that would be helpful.

Q. So multiple images from the same camera from different times is not helpful to you?

A. It is from the perspective that you can perhaps do the same analysis, but it doesn't allow you to do a full

photogrammetric analysis. You're still stuck with one image, which is a unique condition in photogrammetry.

Q. Getting back to this photograph, are many of the same features depicted in this image as the previous image that we were looking at?

A. No, they are not.

Q. Okay. Are there common features?

A. Is there a way to do a split screen so I can bring up -- oh, I'm in control here, am I not? Let me just get my point across here.

Maybe I can do this. Bear with me.

So there was this one and this one. I guess this will be the -- this will be the best I can do at the moment.

Let's look at the back of the pickup that's in the middle here. Can you see any of those features in this image? No, you can't. Let's look at the front of Mr. Finicum's hood. Can you see those features? No, you can't. Can you see the back of this other pickup which is on the left side in here? No, you can't.

You're actually looking at it from the opposite direction, so you can't actually mark or use any common features.

Q. Can you zoom in to the photograph on the right, please, onto the Finicum truck?

A. Yes.

Q. What's the yellow object in the center of the photograph

there, sir?
A. This looks like a headlight.
Q. Is that -- do you not consider that to be part of the front of the truck?
A. I do, but I would just suggest here that if you look at the front of this here, do you see the headlight or the front of the vehicle? Because I don't.
Q. Next. Back to the other photograph, please. Do you see the roof of the truck in that photograph?
A. I see partially the roof.
Q. And do you see the roof of the truck in the other photograph?
A. This one I see, I mean, much better, partially. But, again, is there any way to identify where on the roof I have? Because that's the requirement here.
Q. The roadway is also -- is also depicted in both photographs?
A. Here we see some overlap; but, again, the perspectives are so different that they are effectively very poor images to be matching together in a photogrammetry project.
Q. You testified about the character placement?
A. Yes.
Q. Can you bring up the photograph that you used for that?
A. This -- this is -- the shot five?
Q. Yes, sir. Did you analyze the photographs before -- the

frames before and after this image?
A. I did look at the video before and after, yes.
Q. And did you look at the video at full speed?
A. I looked at it at full speed and frame by frame.
Q. Did you look at any of the enhanced videos that were done by Mr. Piazza?
A. I saw them briefly, but there's a caution against using enhanced videos.

Mr. Piazza talked about sharpening. And what sharpening does, as he suggested, was it changes the edges of the objects. Here, if what we're interested in is the edges of objects, then it's not forensically sound to be using an image that's altered the edges for a photogrammetric analysis.

Q. So you didn't review those critically?
A. I saw some of the videos, and such, that were -- were provided; but, in general, in general practice, you should not be using an altered image for a forensic analysis.
Q. Sir, please answer my question.
A. Uh-huh.
Q. You did not critically analyze those enhanced videos?
A. I'm sorry. Do you mean as -- as part of the camera matching or reconstruction?
Q. Yes, sir.
A. Correct.
Q. In the frames around the photograph that you have on your

screen, the person standing closest to the Finicum vehicle, can you zoom in on that person?

A. Yes.

Q. Are the legs visible?

A. I would say yes.

Q. And does that person move in the frames around that photograph?

A. How much? The question I have is how much is he moving? You say, "Is he moving? Is he moving?"

Q. Does he move from that position where his feet are there?

A. If he had taken a step forward or step back, those types of motions, I would never be able to tell from the video. If you're asking me did he move to the other side of the vehicle or did he move, you know, 10 feet one way or the other, that, I can say, probably didn't happen in those immediate frames.

Q. Did he move to the north or south of the roadway in those frames around that one that is depicted there?

A. Again, to within a small degree, he may have slightly; but within the limitations of the video, not greatly.

Q. Would you agree or disagree that he did not move appreciably from that position? With the qualification that it is the quality of the video that you can determine.

A. Well, I guess the issue there is he says from that position, and that's the issue at hand here is "What is the position?" So I could say that maybe he hasn't moved, but

trying to identify his position is the issue.
Q. The angle of the truck in the snow, do you recall how long after the shooting that was measured?
A. I don't think it was ever clarified exactly, but I understand that it was at 1 -- I started at 1:30 a.m. the -- the day after.
Q. And do you know what time it was measured?
A. I may have -- I may have heard Ms. Dickerson say something earlier in the week. I just can't recall right now.
Q. In your work, do you frequently deal with police officers' total station data?
A. I do.
Q. And do they frequently use poling when collecting that data?
A. There are two methods on the total station. One is a prism pole and the other one is called reflectorless mode where you don't use a prism pole. You can just use the instrument like a point-and-shoot instrument. You look through a little telescope. You point crosshairs, and you hit the button, and it will collect the data.
Q. So it's shooting a data -- a laser to the target and measuring the return?
A. The distance in position of that point; correct.
Q. And have you used -- are you familiar with police officer total station data being collected using a poling method?

A. Yes.
Q. Do you find that to be reliable?
A. Yes. It -- it can be, yes. I mean, you can always make it worse.
Q. And it could always be better; right?
A. It could always be better; it can always be worse. But, normally, in collecting this type of data, it is -- it is reliable.
Q. And it can be affected by the skill of the prism holder?
A. It can be. That's true.
Q. And so, likewise, the conditions could affect it, its collection; right?
A. That is true. But, normally, when you're holding the pole, the way that the method works and if these people were properly trained and as we heard in the testimony earlier in the week, the prism pole needs to be held vertical, and there's a little level on the -- on the prism pole which indicates to the operator when you should be taking a measurement.
Q. That job could be complicated if you're doing it in the snow; correct?
A. It may be more complicated, but you just have to look at the bubble level. And once it's level, it's the same process.
Q. How many data points were collected in that total station that was conducted by the Oregon State Police? Deputy Turpen's data set.

A. Deputy Turpen I don't think gave an exact number, but I thought it was -- I don't know. There were dozens and dozens.
Q. And the more data points that you collect, the more accurate that the diagram is going to be. Would you agree with that?
A. The more -- the more detailed it would be.
Q. Okay.
A. So "accuracy" is kind of a difficult word to swallow, but the more detailed it would be.
Q. Sure. I apologize. I need to be more precise with my language.

Can you bring up the screen where you had the overlay with Deputy Turpen's data, please.

A. Oh, yeah. Oh, do I have it? Oh, yeah. It's right here. Okay.
Q. And --

THE COURT: Wait now. One at a time.

THE WITNESS: I just wanted to know exactly -- is this okay? This view here is all right?

BY MR. MALONEY: (Continuing)

Q. That works for my purposes.
A. Okay.
Q. Now, there appears to be a data point here. Is that right?
A. Yes.

Q. And that line, that red line, runs up north -- in a northerly direction, does it not?
A. Correct.
Q. And can you zoom out a little bit, please?
A. This way?
Q. So I had circled that one there. What does that connect to from the northerly direction? Where is the next data point?
A. Okay. I think I see what you're getting at. And to be fair, normally, when officers take total station measurements on the roadway, they may not always go in very fine increments. So if there's a curved road and they make a big jump, there -- there -- when they connect the lines, obviously, in between, we haven't mapped that area. So what you're seeing is a straight line in between the two. That is not -- this line is -- in fairness, is not a mistake. This line is just indicating that they've connected two points which are far apart.

And, in fact, if you look at Mr. Terpstra's survey here or the other set of lines, they adhere much better to the curvature of the lines.

Q. Okay. And so the yellow line that you have highlighted, that is from Mr. Terpstra's total station data?
A. I believe it is. I believe it is.
Q. And you indicated earlier in your testimony that you pointed out an offset of 2 inches between the red line and the 3D scan data?

A. No. What I indicated was that Mr. Terpstra's total station survey data -- and I can show you again. Let me blow it up. So there are areas where these lines on the right here do not overlap very well with here, and so some of those areas are up to 2 inches.

So, for example, this yellow line here, right, you can see that this is Mr. Terpstra's data, and that's the scan data. So there's a shift there left to right.

So I'm not -- I'm not talking about the OSP survey. I'm just talking about the data that was collected by Mr. Terpstra.

Q. Are --

A. I'm -- just so you're aware, what happens is when the police go out there and they start taking total station measurements, they're not always -- they're not always taking the roadway to a very high, high degree of accuracy. So what you'll see is -- and I can point this out to you, just so you get it. If you look at the points which are taken and where they were taken, you'll see that some of these points may be not exactly centered on the lines.

So let me go back here. This is a better way. I know there's some down here. So, for example, that's the -- this is the setup point over here where the total station was. But look here. This one is kind of in between the two lines in the center. It looks fairly well-centered; whereas, if you look at this one, it's not too bad. But they change their position.

Sometimes they take the center of the line. Sometimes they take -- so, for example, here. This one is a little bit off-centered more. This one you'll see between these two lines is here. There's -- they get close to the line, but they may not always have a standard procedure of, okay, I'm going to take the inside of the line every time. Sometimes they go to the center of the line; sometimes they go to the outside.

Q. Were you aware that the southern data points that you've got illuminated right now were collected on a different date?

A. These ones here?

Q. Yes, sir. Did you -- were you here for Deputy Turpen's testimony?

A. I was.

Q. When he testified that he collected the points leading up to the roadblock so that he could do a speed analysis, and he did that on a different day?

A. Sure. That's fine.

Q. So that could explain the differences; right?

A. No.

Q. Okay.

A. I mean, yes and no. I mean, do you mean the differences related to this particular part of the survey? There could be some things there. But, like I said, I think the bigger issue is where they take the points and how it aligns to the scan data.

Q. If they were taking different points on the -- when they went out to do the extended road survey, after they had completed the survey the night of the incident, if it's a different person, they might be collecting the data a different way?

A. Correct. But it still should align to the scan data.

Q. You testified you used manual camera matching as a last-resort method?

A. That's correct. Because it is the most subjective.

Q. And -- but, yet, you use it in your work?

A. No.

Q. Just not for this case?

A. Manual camera matching we're talking about here, which was done in this case, is not something that I use in my regular work.

Q. How do you do it?

A. I always start with photogrammetry, and we start at the top. And what I mean by that is you see if you can do a photogrammetric analysis, and then we work our way down from there. So it changes depending on the type of evidence that I have.

Q. Now, in your analytical photogrammetry solutions, are you using PhotoModeler?

A. That's one of the tools I have, one of the main tools, yes.

Q. To do that analysis, you have to pick the points that you align the photograph to; correct?
A. That's correct.
Q. So there's some human subjectivity to the alignment?
A. There is.
Q. If you pick a bad point, then you're going to get a bad result?
A. So that's an interesting point. So the answer to that is yes. The software will tell you that you have a bad point. And that is the benefit of using that method, is that it gives you information back to tell you that statistically there's a problem with some of your points. And there are other benefits to using that method as well.
Q. One of the issues you had with Mr. Turpen's -- or Terpstra's analysis was the subjectivity involved in his camera matching? Correct? Right?
A. The methodology itself is subjective by nature, yes.
Q. I'm changing gears here. We'll talk about subjectivity for a little bit. All right?
A. Yeah.
Q. The fact that he used -- that there were multiple individuals working on this solution, does that help reduce the subjectivity? It's not just one person doing it. It's multiple people working together for a camera match solution?
A. Well, that's not how it works. How it works is you need

multiple people working independently and blind. That's how the method works.

Q. And I believe your testimony earlier was that you agree multiple camera matches can help a -- reduce subjectivity?

A. No. That's not -- that's not what I think I said. And if that's what I said, that would not make sense.

Q. Okay. Let's verify.

A. Just to be clear, multiple camera angles is what photogrammetry -- what photogrammetry actually is.

When you take a photograph of an object at multiple angles, you can then run a full photogrammetry analysis. That's what happens. When you only have a single image, then that analysis is unique. It's called a resection.

What we're doing here is taking multiple resections and putting them together.

In a full photogrammetry analysis, those individual photographs and those points are all tied together. What we have here is subjective, subjective, subjective, subjective. So you have a lot of subjectivity.

You're asking is there a benefit. Yes, there's a benefit to help perhaps reduce or minimize some form of error, but it doesn't remove the subjectivity.

Q. And the -- the wiggle test involved, does that help reduce subjectivity, knowing that you're evaluating for individual pixels relative to the placement of the character in the model?

A. Well, subjectivity is the problem here, and so the -- having a discrete point that you can mark is what we're after. And when we don't have that, that window becomes very wide. So we have a blurred image. We have all kinds of problems.

Now it's up to myself or somebody else to say, "Well, it's not a big deal. I can -- I can pick that. No problem." Somebody else says, "Oh, this is serious. I can't really pick this point very well because it's all over the place." That's the problem. There's no standard. There's no way to say what is the true and accurate position.

Q. Do you use multiple people in your work?

A. At times, yes.

Q. Do you blind them when you work in PhotoModeler?

A. I do, yes.

So we're currently working on a couple of cases right now for the police, and that's exactly what we do. So when we do a suspect height analysis case, I get the information, I distribute it, and I ask my people not to discuss it with each other. And at the very end we throw all the cards on the table and say, "This is what we've got," and then you can go back and you analyze your results.

Q. Sir, are you familiar with this photograph that I'm showing you now? Have you seen it before?

A. Yes, I -- I have.

Q. If you accept the representation that the list of your

shift 2 degrees clockwise is depicted by the yellow outline and the green outline is the Kineticorp or Mr. Terpstra's alignment, do you agree or disagree that that is in alignment at the 2-degree counterclockwise rotation?

A. I agree that there's some misalignment. I'll leave it at that. This was a demonstration. This was not me trying to say that is where it is. What I was trying to show was when you're looking at the image, the full image, and farther out, it's much more difficult to see these kinds of things, both in the people and with the vehicle.

And in other images -- in other images you can see that it may be more aligned. And the problem with that is, as I've shown with the position of the camera match to the total station data, that you can make it work in your favor, but you can still be under a grave misapprehension about the actual position, and that's the problem with subjectivity.

Q. This was the position that you subjectively chose to depict the 2-degree rotation, was it not?

A. It may be. It looks like it.

Q. But, plainly, when you look at it from another position, it's out of alignment?

A. Well, yes. And so let's think about this.

Q. Thank you, sir. You answered my question.

Now --

A. May I explain?

THE COURT: You can explain.

THE WITNESS: So what I would like to explain there is is when you move to another position, there could be things working against you. And one of them is, as we've shown already, as Mr. Terpstra testified to, he doesn't know where the actual camera was, and so -- and, again, I don't mean this offensively or anything, but I don't know that if, you know, somebody said, "Well, it doesn't look right in this image. Let me go ahead and tweak it," I can tell you, with certainty, there's no way that 12 images lined up right off the bat perfectly. It's an iterative process, which means you go back, you adjust, you tweak, you adjust, you tweak to get what you want. That's not how this works. You need an analytical method to tell you when you're wrong. So we don't know that when people were in the vehicle the vehicle was tilted slightly and from another photo it had changed by a degree. We don't know that in between some of these images it shifted slightly. We don't know that it sank in the snow. There's many factors. We don't know that from one image to the other we're actually at the proper and true method.

So, you know, Your Honor, all I can say is that whenever I see things like this and they look perfect, I get suspicious. You know, nothing is perfect. You know, and usually when we do these types of analyses, we find that they are not in our favor.

BY MR. MALONEY: (Continuing)

Q. You asserted that you could move the alignment of the vehicle up to 7 degrees and that it wouldn't be detected in your direct examination.

Do you recall that?

A. I did not say that.

Q. What did you say about the 7-degree shift?

A. I was asked how many pixels would represent -- I'm sorry. Let me go back. What I said was -- or asked was how many pixels would 15 centimeters represent in the images? And in that image it would represent 4 pixels. So it would be 6 inches 15 centimeters represents 4 pixels. And I was asked to give a demonstrative, and I believe I explained at that time that, in fairness, that does not represent the actual shift of the vehicle in any way. It's strictly a demonstration.

Q. You would agree that a 7-degree shift in the vehicle of the Finicum truck would be readily apparent from the alignment; correct?

Let me rephrase that question so I can put it in better context.

A. Yes.

Q. I showed you a picture with that truck in -- with a 2-degree clockwise rotation?

A. Correct.

Q. And you agreed that there appeared to be some misalignment

in that photograph as I depicted it.

A. What I agreed to is that that misalignment is based on a certain camera match that we don't know. So it's not -- it's not that it's impossible, that it couldn't happen, because there's no way for you to detect it if there's a shift in between these images.

And, again, we're -- we're -- yeah.

Q. But my point being if it were a 7-degree clockwise rotation, that would be even more apparent?

A. Well, there was a 5-degree shift is what we're talking about here. There's a difference in two of these analyses, and nobody seems to have noticed that shift either, so how can I be confident?

Again, looking at the scan data, looking at the camera match position and the total station data says it all to me. We're not in the right position. There's something wrong with this model. And, again, you know, I can't make it work. I can't, you know, invent anything other than to say that we have an issue here, a major issue, and it needs to be either addressed or we need to say, look, we've hit the brick wall. We can't do any further.

And sometimes, in our willingness to help as experts, sometimes we -- we maybe go too far. But in this case, all I can say is that we have to be very careful about this.

And we're showing right now that there are fundamental

issues. Fundamental issues here that go beyond the science, what the science can deliver. And so, you know, I'm trying to make this apparent; but, yeah, I don't know how else to say this.

Q. Did you attempt to do an analytical photogrammetric solution for the data in this case?

A. No, I did not.

Q. Sir, do you have my box up there?

A. Yes, I do.

Q. Can I have it back?

A. The famous box.

Q. You were demonstrating that if the -- the poling positions were next to the truck at the time the data was taken that it couldn't be aligned properly in the 3D model with the overlay that Mr. Terpstra performed with the red lines.

Do you recall that testimony?

A. Yeah. So there's a mismatch between the two, which is contrary to the logic of what we believe happened in this case.

Q. So can you bring up the photograph that depicts that, that you were using when you testified in direct exam?

A. Yes.

Q. And the assumption that you're making is that the vehicle settled?

A. Uh-huh.

Q. Right?

A. Uh-huh.
Q. And that is based upon what fact from the investigation?
A. Based on reports, based on the witnesses from this week, based on the scraping of the door, based on differences in the trajectories that were shown to me.
Q. Now, this truck was on a suspension, was it not?
A. Yes.
Q. And the suspension allowed the wheels to move up and down so that it smooths out the ride of the truck?
A. Yeah, it may.
Q. And is it possible, sir, that the -- that an explanation for the snow scraping could be someone's getting out of the truck and opening the door and the truck moves on its suspension while the door is being opened and moving the snow? Could that be an explanation?
A. My understanding is that -- and correct me if I'm wrong -- is that every time they opened and closed the door -- and that's what I heard this week was it's not somebody getting out of the car. Every time they opened and closed the door, it was sinking lower. That's what I heard this week. And if I am, then I don't know. That's what I heard.
Q. I'm asking if it's possible.
A. You're asking if somebody is in the car and getting out and if it could be sinking?
Q. That the -- that it could be -- that the suspension could

lower with the change in weight of the person getting out of the truck.

A. No. When they get out, it goes up. There's less weight in the car.

Q. But if you're leaning towards that side of the car as you're getting out, could it move the truck?

A. Again, as you're getting out, you're putting less weight in the car. It doesn't make sense. Are you going heavier on that side or lower?

Q. I'm saying if it's heavier on the side that the person is getting out on, could that lower the truck?

A. That's not what you asked originally, but yes. If you put five people on the driver's side or on the thing, then it's going to go lower on that side.

Q. And, Mr. Liscio, you're getting agitated, and I'm not trying to be provocative, sir.

A. I'm sorry. I'm sorry.

Q. I'm just trying to get to the truth here. Okay?

A. Okay. I'm sorry.

Q. Please be patient. It's possible, right, that the shift in weight could shift the suspension, and that could cause that snow to move; right?

A. Yes, it is possible.

Q. Okay. And would you agree that it's possible that the truck settled unevenly through the evening as another possible

explanation?
A. Yes. That is possible.
Q. And it's possible that in the middle of the night in the snow, in the cold, the person pulling the front rear corners of the vehicle didn't exactly hold that completely level?
A. Here is the problem with that suggestion -- and I thought I made it clear, but I'll make it again. If you look at where these points are, so there's a point on the front bumper, there's a point on the back bumper, they are to the right of the vehicle. If you look at the point which is in the rear bumper, it is to the right of the bumper. It's in the bumper. You can't do that.
Q. Unless the truck settled unevenly; right?
A. No. No. This is -- let me finish, please. The one on the right here is also to the right. The bias is the same for all four points. So that means that the person has to bias the pole the same way in the same direction each time. And what you're suggesting is is that when it's settling it settled up the hill, not down the hill. There was a wall of snow that everybody says was piled up on the side of this door, and you're suggesting that it settled up the hill. It's contrary to what makes sense.
Q. Shifting gears. In your binder, there is Government's Exhibit 38. Different binder. The one that says "witnesses." Yeah. Look all the way in the back.

A. 38, you said?
Q. Yes, sir.
A. Okay. I have it.
Q. And is that from SAE International?
A. Yes, it is.
Q. Are you familiar with that publication?
A. Only briefly. I just saw it and quickly read through it on the break.
Q. That -- was that listed in Mr. Terpstra's list of case -- or list of authorities?
A. It may have been. I just don't recall right now.
Q. Okay. And, sir, I -- I want to be fair. If you need more time with the material, I'm happy to let you have the time that you need.
A. No, I'm fine.
Q. Okay. Can -- what was -- what was it that this study did?
A. This study here was a comparison of using a single-image photogrammetry to using a drone, a UAV, with 4k video, so -- which is from a -- like a typical GoPro camera. It was looking at the comparison between the two, basically.
Q. Okay. So it's a -- it's one of those papers, like you talked about, trying to prove that this might work?
A. Let me guess. Is this from Kineticorp? Yes, it is. So yes. But, nonetheless, I'm not trying to be too critical here, but what I'm saying is that -- and we do the same thing at the

university because sometimes blind studies and everything are not all that practical. Let's face it. Right?

But, no, I accept this for what it is. It looks like a good study.

Q. And just in general, what were the conclusions about the drone -- the precision and accuracy from the drone photographs compared to the precision and accuracy from the photographs from the ground?

A. Let me -- let me find something that's -- I mean, it gives a -- it gives a -- it gives a table here, looking at some of the errors or the average errors, you know, and it talks about, you know, different software packages which give better scan data and that sort of thing. Excuse me. Point cloud data. And, I'm sorry, I'm trying to find where it says about the single -- the camera matching.

Q. Turning to the discussion and conclusions --

THE COURT: Well, read what you want, please.

THE WITNESS: Yeah, it would help me.

BY MR. MALONEY: (Continuing)

Q. "This paper has demonstrated an accurate technique whereby the photographs or video may be used as an integral part of an evidence reconstruction process that is accurate to about a half inch."

THE COURT: Your question, then?

///

BY MR. MALONEY: (Continuing)

Q. Were you aware of this study?

A. Not previously, no. However, if I may qualify that. We actually did a similar study with university students at the University of Toronto where we actually used a GoPro camera -- or not a GoPro, but the same UAV. We used laser scanners and total stations all together to make a comparison. This particular study is using 4k video, which is very high. Again, you know, it's the same thing. If we look at the images, they're crisp, they're high resolution, and they're only at, like, 20 meters away from the surface, the ground. In those kinds of conditions, you can get good results.

I can tell you that our results were slightly different than this one, and we did a different statistical approach, but we found that most of the points are within 5 centimeters and when you're creating, like, point cloud data. So we're not really comparing apples to apples here.

What we need to find is a study from that camera that's two miles away, using a panning camera, people moving, and let's create the same conditions, and let's see what kind of results we get.

Q. When conducting manual camera matching --

A. Yes.

Q. -- is a user's experience an important factor to consider?

Again, kind of the same example with me and Mr. Noedel.

Right? If he took me out on a shooting scene, he would only let me take measurements under supervision. If I was asked to do -- if I was your employee and you had a camera match to do, would you let me do it?

A. This is the problem, isn't it? When you're using a subjective method, we want to try a method which is independent of the examiner that's doing it. That's why DNA and things like that are so powerful.

So if -- if you're asking can a person who's experienced possibly do better, maybe. Maybe. But not necessarily. Not necessarily.

Someone with little experience can do actually quite well. And I would go back to where I was two weeks ago with a class of 30 police people doing suspect height analysis with photogrammetry for the first time, and out of 30 people, a blind test -- this was completely blind -- the results were excellent using an analytical method. When we did a subjective method, we actually -- we actually compared three methods. When we used a method which was much more subjective, the dispersion of results was clearly evident. Right?

MR. MALONEY: Those are all my questions. Thank you, sir.

THE WITNESS: Thank you.

MR. FRANCIS: No questions.

THE COURT: Thank you. You may step down, sir.

THE WITNESS: May I have a moment to take my things away or should I wait?

THE COURT: Sure. We're going to break for lunch, so I kind of -- I've been squeezing your lunch hour. Yesterday you got an hour. The day before we got pushed way over the time. Would your preference be to recess until 1:15?

MR. FRANCIS: That would be fine for us, Your Honor.

MR. MALONEY: That will work for us, Judge.

THE COURT: Give me an idea of where we are.

MR. FRANCIS: Your Honor, the defense's next witness will be Clifford Mugnier, and I believe after he testifies the government has one more witness to go.

MR. MALONEY: That's correct.

THE COURT: Thank you. So we'll just see where that takes us. I'm not going to predict. Thank you.

MR. FRANCIS: Thank you.

THE COURT: Court is in recess.

(Recess taken.)

THE COURT: Please be seated.

MR. FRANCIS: Mr. Maloney, do you want to bring this up now or --

MR. MALONEY: Your Honor, over the break, the government has consulted with Mr. Terpstra. We would like to briefly recall him to the stand at the conclusion of the defense experts.

THE COURT: That's fine.

MR. MALONEY: Thank you, Your Honor.

MR. FRANCIS: Your Honor, the defense calls Clifford Mugnier.

THE COURT: If you're still willing, you can come on up here to sit in the jury box so you can see the displays.

MR. LISCIO: I'll accept your invitation.

CLIFFORD MUGNIER,

called as a witness in behalf of the Defense, being first duly sworn, is examined and testified as follows:

THE WITNESS: I do.

DEPUTY COURTROOM CLERK: Have a seat, please. Come forward, speak into the mic, and spell your full name for the record, please.

THE WITNESS: Clifford Mugnier. C-l-i-f-f-o-r-d, Mugnier, M-u-g-n-i-e-r.

DIRECT EXAMINATION

BY MR. FRANCIS:

Q. Good afternoon, Mr. Mugnier.

A. Good afternoon, sir.

Q. Mr. Mugnier, can you please tell us about your professional background.

A. I graduated from Northwestern State University in Louisiana, majoring in geography and mathematics. I went to work as a cartographer for the U.S. Air Force Aeronautical Chart and Information Center in St. Louis and was in full-time school there, 40 hours a week, for six months, where I got a greetings letter from Uncle Sam and wound up in the Army.

So I went through OCS and volunteered indefinite service to get assigned to Army Map Service, where I was a topographic engineer there, eventually reaching the rank of captain. I started off in the extraterrestrial branch in analytical photogrammetry where we were doing the photo triangulation for the Apollo landing series for the first landing on the moon.

Afterwards, I got my top secret SCIF clearance and was doing research in production-oriented photogrammetry for the CORONA program, which was the spy satellites used for topographic mapping of areas denied to the U.S. Government.

When I got out of the service, I went to work for a commercial mapping firm in the Boston metropolitan area, and, from there, I wound up back home in Louisiana running a topographic mapping firm for a number of years until I moved finally back to New Orleans where I raised most of my kids there as a full-time consultant and part-time member of the facility at the University of New Orleans in the Department of Civil Engineering.

So I taught photogrammetry at UNO for 20 years and then

when I joined LSU full time and just went part time into consulting, I've been teaching photogrammetry again for an additional 18 years. I've done forensic photogrammetry for about 40 years. Most of it analytical. A little of it graphical. And I've also done other types of close-range consulting work, including shooting monkeys and sailors out of ejection seats for the Navy Medical Command.

Q. How do monkeys and sailors compare when you strap them into a ejection seat?

THE COURT: Let's get on with it. That's fine.

MR. FRANCIS: I apologize, Your Honor. It's --

THE COURT: He's well qualified. Let's get to the substance.

MR. FRANCIS: It's a good story, but we'll leave it for another day.

BY MR. FRANCIS: (Continuing)

Q. Mr. Mugnier, the Court has already received and I would offer into evidence as Exhibits 11-1 and 11-2 your CV and report. Do you adopt those for your testimony today?

A. Yes, sir, I do.

Q. Mr. Mugnier, when we retained you in this case, did we ask you to go out and do your own analysis to try to determine where the people and places were?

A. No, sir, you did not.

Q. Am I correct to say that when we -- excuse me. Let me

start that question again. Am I correct to say that what we asked you to do was evaluate the work that Mr. Terpstra did and tell us what you thought about it?

A. Indeed. That's what you asked me to do.

Q. And do you understand that the purpose of this hearing this week is to evaluate the reliability of what the government's experts did in this case?

A. Yes, sir. I have testified before in *Daubert* hearings.

Q. Mr. Mugnier, what is photogrammetry?

A. Photogrammetry is the science of obtaining reliable dimensions from imagery, whether it be film, digital, X-ray, what have you. It employs the mathematics of projective geometry and statistics, including the primary use of least squares.

Q. What do you mean when you say "least squares"?

A. We try to obtain as many measurements as possible of the imagery, and when we get more measurements than we need for an answer, we then go into a mathematical solution such that on analysis the result of the sum of the squares of the residuals are constrained to a minimum, so the least squares.

It was first developed by Carl Friedrich Gauss in the early 1800.

Q. I appreciate that this might be a simple analogy, but fair to say if I have two points, that's enough to make a line; right?

A. Yes, sir.
Q. If I add a third point to that, I can tell how close that line is to being the correct line described by those points?
A. Indeed. Correct.
Q. The third point is a check on the first two points?
A. Yes, sir.
Q. Each additional point we add onto that increases the -- well, what is it? Increases the reliability of the result? How would you put it? As we add more data points to the project, what are we increasing or decreasing?
A. It give us a measure of the accuracy.
Q. To the extent that it's different than what you've just testified about what photogrammetry is, what is analytic photogrammetry?
A. It's merely the mathematical representation of what we can see visually with two different images. And as we add additional images that are impossible for us to perceive, since we only have two eyes, we just get a stronger mathematical solution with a better metric on the accuracy attained.
Q. All right. And were you in court for Mr. Terpstra's testimony yesterday?
A. Yes, sir, I was.
Q. Did you hear him describe his technique for, quote, "camera matching photogrammetry"?
A. Yes, sir.

Q. Is camera matching photogrammetry, in fact, photogrammetry?

A. I guess in a slight way. It's a -- it's a method of visual estimation where one attempts to match preexisting imagery.

Q. And have you formed an opinion on whether the technique of camera matching gives accurate results?

A. It can give plausible results, but there's no way to measure the accuracy achieved.

Q. Why is that?

A. There's no measurement process where we can take a look at residuals of how far something is from a mean or an average, and, as a result, we just -- the graphic -- the only check we have is a graphical analysis. We look at it visually, and, to our eyeball, does it appear plausible or not? So it's a very subjective way of guesstimating whether something appears that it might match or it might not.

Q. And what is the significance when someone employing camera matching says that images align or they match? What, if anything, can that alignment or matching tell us about the true location of objects?

A. Nothing at all other than for the personal opinion of the evaluator. They have to weigh what appears to match versus what does not appear to match, if any, and then come up with a subjective opinion to vote yes or no.

Q. But even if we take an image that does appear to align correctly, what, if anything, can we say, then, about the accuracy of the answer that that process gives us?
A. Say it again, please.
Q. Sorry. So in the process of camera matching, let's say we look at an image and we would all, in this courtroom, agree that it looks like it lines up to us, what would we be able to say about the accuracy of that answer -- the accuracy of the location that camera matching tells us an object is in?
A. I guess you could ask all the different individuals evaluating that, what their opinion is, and sum that up to try and get some metric, but it's not something that I use.

So my opinions on the intricacies of the method are pretty much as a layman.
Q. Sir, are there situations in which camera matching gives better answers than others?
A. Perhaps. But I really don't have any experience with camera matching since it's something that I wouldn't dare use.
Q. Why wouldn't you dare use it?
A. Because there's no way of explaining what accuracy has been achieved. And the whole idea for a forensic objective is to find the truth, and you really wouldn't know that.
Q. I just want to -- I want to unpack something you said a minute ago here. Just because you haven't dug into a computer and manipulated 3D images and done this yourself before, does

that mean that you have no opinion on the accuracy of the results that one could theoretically achieve from this process?

A. Well, no. It's merely a computerized version of reverse projection.

Q. What is reverse projection photogrammetry?

A. Reverse projection has been used in the Second World War -- I don't think the First World War -- in that they could take imagery that had been already obtained and put it into the focal plane of a camera and then try to find a location where the imagery appears to match.

If they are fortunate enough to use the same camera and the same lens, what they would be doing is achieving what is called the Schiem Pflug principle.

THE COURT: Spell that.

BY MR. FRANCIS: (Continuing)

Q. You're going to have to spell that.

A. S-c-h-i-e-m. P-f-l-u-g.

And that's the -- the desired objective of totally manual, with an old photograph, and trying to achieve the location where that photograph was taken.

That has been also used by the FBI in very controlled environments and is -- is what we attempt to do analytically with mathematics, which is far simpler than the manual technique.

Q. What type of controlled environments are better for the

use of reverse projection technique that -- what do you need to control in the environment to make this work?

A. Same camera bolted to the wall, pointed in a single direction, and furniture stable or bolted to the floor. A regular grid pattern in tile or rugs. Kind of like what's required by the FDIC for the interior of banks, for tellers, in case there's a bank robber.

Q. Is that why that's required by the FDIC, so that this kind of analysis can be done after the fact and get accurate answers?

A. Yes, sir, it is. And it has been used for decades by the FBI specifically for that purpose. And on occasion, in controlled environments, I have read and heard from some society presentations that the FBI has used it on occasion for outdoor situations.

Q. Turning to outdoor situations, then, what is the significance in camera matching or reverse projection, to the extent they're similar, to whether -- in placing objects that touch the ground? Why is whether an object is touching the ground significant?

A. In photogrammetry, to achieve a mathematical solution, you have to base it on the laws of geometry and perspective. So, analytically, there are only two kinds of equations that this can be expressed as. The eight-parameter projective transformation and the collinearity equation. The collinearity

equation is used primarily for stereoscopic situations where you can see in 3D. For a single photograph that's portraying three-dimensional objects, you have to choose a plane of rectification.

Q. A flat surface?

A. A flat surface. Because the image plane that's in the camera is either film or a CCD chip, and that's flat. And we want to transform the image that's on that focal plane, commonly, to the floor. And when you do that, then you can determine the position of objects relative to each other in only that plane. A photograph has an infinite number of scales. So when we constrain it to a single plane, then we can determine relative positions of objects in that plane.

We can't determine the height of anything or out of the -- what's, for instance, the X-Y plane.

Q. So, for example, if we had a flat road, would that be an example of a plane that you could use to try to do the calculations you're describing?

A. Yes, sir, it is.

Q. Now, if we, instead, have objects that are not on the flat road but are, instead -- and I'm going to say the word "floating" -- and I'll explain what I mean by that -- but are, instead, floating above the road surface -- for example, they're not -- they are -- they are on a pile of snow that isn't there back when a scene is scanned later on.

A. Yes, sir.
Q. If an object is floating like that, what type of mathematical calculations are possible at that point?
A. From a single photograph?
Q. Correct.
A. Nothing. You need two or more photographs to determine the position and orientation of anything that is not in contact with that plane.
Q. Do those two or more photographs have to be taken of the same objects in the same positions?
A. Yes.
Q. Is there any validity to a method that uses two or more photographs when you cannot assume that everything has remained exactly in the same place?
A. No, sir.
Q. What, then, is the significance of a camera match where objects look like they are lined up with a background image from a single photograph? If we look at an image and see that things line up in a single photograph, shouldn't be we able to figure out, using the method Mr. Terpstra has described for us, where things are located in 3D space?
A. One would hope so, but you can't. Mathematically, it's not possible.
Q. Now, Mr. Mugnier, I understand that you have brought a device with you today called a stereoscope. Would you mind

pulling that out and showing the Court?
A. Yes, sir.
THE COURT: Thank you.
BY MR. FRANCIS: (Continuing)
Q. All right. Mr. Mugnier, what is a stereoscope?
A. A stereoscope is a device with -- in the simplest form, two lenses, sometimes adjustable for the distance between a person's eyes, called inner pupillary distance. Most people are around 65 millimeters. And it allows one to look at two images, hopefully from different perspectives, so that one can achieve a three-dimensional image.
If one looks at two photographs that are identical, all you see is -- of the flat image of a photograph, and there is no depth because there's no difference between the two photographs. The two copies of the same image.
Q. And what is the significant of -- well, let me ask this another way. You've created some -- you created some exhibits in preparation for your testimony here today; correct?
A. Correct, sir.
MR. FRANCIS: Your Honor, may I approach and hand these up to the witness?
THE COURT: Any time.
BY MR. FRANCIS: (Continuing)
Q. There you are, sir.
Mr. Mugnier, can you tell the Court what I've just handed

you, please?
A. Yes, sir. These are a -- several images that were taken from Mr. Terpstra's report and appendix of exhibits in digital form. The photographs were .pdfs or .jpgs. And what I did was I took a few of them at random, brought the digital images to a nearby Walgreens Drug Store, and got some 3 x 5 color prints of those, and I had multiple copies made so that one could compare photographs before and after Mr. Terpstra's attempted reconstruction of some digitized images of vehicles to overlay the visual actual photographs.
Q. Would you mind handing one or two of those over to the Court, please? Just so -- just so everybody can follow along with -- or perhaps we can hand -- hand them out to the room.
I'm going to ask you some questions about what these -- what is on these various images, but I want to make sure people are following. If you want to hand -- hand -- let me grab one or a couple. Thank you.
Now, you have a number of these; right?
A. I have two.
Q. All right. Well, you prepared a number of these, though?
A. Yes, sir.
Q. Each one is different?
A. Correct.
Q. But if we flip it over and look on the back, we can see which pages from Mr. Terpstra's report these images come from?

A. Yes, sir.
Q. Okay. But in general structure, have these all been prepared the same way?
A. Yes, sir.
Q. Okay. Let me see if I understand what we're looking at here correctly. From the top series of images, the top right and the top left, what are those two images supposed to be?
A. It's the identical image that shows the lines Mr. Terpstra overlaid the image with the laser scanned lines of the centerline and fog lines.
Q. So we have the photograph, and we have an overlay of the lines?
A. Yes, sir.
Q. Okay. And by "photograph," I'm also referring to frame of video as well.
A. Yes, sir.
Q. And then for the bottom pair of images, what are we looking at?
A. In the bottom, on the left-hand side, shows the images of the vehicles that have been superimposed over where the actual photographic images are, and on the right-hand side is a duplicate of what's on top.
Q. When you say on the bottom left-hand side there are vehicles superimposed, is it your understanding that these are the 3D models as positioned by Mr. Terpstra in his diagram?

A. Yes, sir.
Q. Okay. And if we are -- if we take your stereoscope and look at the pair of images on top --
A. Yes, sir.
Q. -- they're the same image; right?
A. Correct.
Q. So what should we see when we look at that pair of images through a stereoscope?
A. With both eyes we see a flat photograph. There is no depth whatsoever because the two images are identical.
Q. And for the bottom photograph, if we look at those two images --
A. We do see depth.
Q. Where would --
A. And --
Q. I'm sorry. Finish your answer.
A. We do see depth, and the depth is solely in the superimposed images.
Q. So the rest of the image -- the road surface, trees, snow, lines -- that would appear flat even in the bottom pair of images?
A. Yes, sir, it would.
Q. Why is that?
A. Because nothing has changed.
Q. But for the vehicles, we would see what?

A. We would see depth, indicating that it's not a perfect match. There is graphical error evident to the naked eye when using a stereoscope. Since there is no way of getting a numerical handle on the errors involved in the camera matching process, it's a totally graphical process on the computer. This is a manifestation of the inherent errors as seen with a naked eye.

Q. And, as I understand, this is somewhat of a demonstrative process. So if we wouldn't mind, perhaps we can take the stereoscope and pass it around to the Court and --

A. Oh, if we take the stereoscope, put it over the top two, and look with both eyes, we see a single image with both eyes and no depth. If we then slide it down to the bottom two photographs and look through it, the superimposed vehicles appear to be floating in space. The one that is -- shows Mr. Finicum's vehicle, as well as the blocking vehicles, are not flat and smooth in comparison to the remainder of the photograph.

MR. FRANCIS: And if the -- if Your Honor would like, Mr. Mugnier can hand that up and --

THE COURT: Sure. Give it to my clerk.

DEPUTY COURTROOM CLERK: They don't go on your head. They go down. Flip it over. And now --

THE COURT: Not doing very well here.

THE WITNESS: No, sir. You put it on the board

itself.

THE COURT: Show me.

THE LAW CLERK: Like this, and put it through that.

THE COURT: Put it like that. Okay. I got it. Am I doing it right now?

THE LAW CLERK: Spin it around.

DEPUTY COURTROOM CLERK: And then your nose will fit in there.

THE WITNESS: If you go to the top two first, Your Honor.

THE COURT: Okay.

THE WITNESS: You just see the same photograph flat with both eyes. And when you go down, the difference is the -- the floating appearance of the vehicles.

THE COURT: Yeah.

THE WITNESS: And if you blink from left to right, you blink back and forth, then you see the mismatch of the superimposition with the original photograph image of the vehicle.

THE COURT: Got it. Thank you.

THE LAW CLERK: Do you want to see another one?

THE COURT: That's fine.

MR. FRANCIS: The government is welcome to come up and take a look at it now if they would like, or we can save it for the break.

THE COURT: Do you want to look at it now?

MR. SUSSMAN: No thanks.

MR. MALONEY: No thank you, Your Honor.

THE COURT: All right.

BY MR. FRANCIS: (Continuing)

Q. Mr. Mugnier, what is the significance of seeing the vehicles, in this case, appear to be in 3D in the bottom pair of images? What does that mean?

A. What it means is the idea of doing camera matching is looking at a single image and trying to get it to match some other image or to develop the same perspective. And when looking at a single image with one eye or two eyes, you have no depth perception.

So if we use the original image and the superimposed image, one viewed with each eye, there's not a perfect match. And that means that there's errors in the superimposition process for that single image. And any superimposed image that you have in the report submitted by Mr. Terpstra shows this blunder in eyeballing or visual estimation that's impossible to do with a monoscopic image.

To do this sort of thing, it has to be done stereoscopically to achieve any kind of success. And you see the mismatch that is both in terms of left/right matching as well as any apparent error in the rotation of the image with respect to the aspect view of the individual photographs. And

this sort of graphical error is evident in everything that's done. There's no numerical handle on the residuals or an accuracy estimate; but, graphically, you can see the errors.

MR. FRANCIS: Thank you very much, Mr. Mugnier. Could you please answer any questions that the government may have for you.

CROSS-EXAMINATION

BY MR. SUSSMAN:

Q. Good afternoon, sir.

A. Good afternoon.

Q. You, I must say, have a very impressive resumé.

A. Thank you, sir.

Q. You're welcome. You've done a lot of mapping and cartography work?

A. Yes.

Q. A lot of mapping and cartography work.

A. Indeed.

Q. You've done a lot of work with satellite imagery?

A. Yes, sir.

Q. And you have a very strong background in mathematics?

A. Yes, sir.

Q. Which I most certainly do not.

But I don't see where you've done any computerized 3D scene re-creation. Have you done anything like that?

A. No, sir. That's not my field.
Q. Never. You've never done anything like that?
A. No.
Q. Have you used the Studio Max 3D computerized software program?
A. No, sir.
Q. Okay. You mention in your report that you don't really think that camera matching photogrammetry is photogrammetry at all; right?
A. More or less, that's correct.
Q. You don't think it's science at all, do you?
A. No. I think it's art.
Q. In fact, you've described it as little more than subjective graphic art in your first declaration.
A. Yes, sir.
Q. And today I think you said that you define photogrammetry as the science of obtaining reliable measurements from photos.
A. And imagery.
Q. And imagery?
A. Yes, sir.
Q. You remember the American Society of Photogrammetry and Remote Sensing?
A. Yes, sir. I'm a fellow.
Q. So you're aware that that organization defines photogrammetry a little differently; right?

A. Somewhat, because they are also including remote sensing.
Q. So that organization includes -- defines photogrammetry, in part, as the art, science, and technology of obtaining reliable information about physical objects and the environment through processes of recording, measuring, and interpreting images?
A. Yes, sir.
Q. And wouldn't that definition be broad enough to include camera matching photogrammetry?
A. Well, since part of the definition is art, perhaps so, but certainly not in my division.
Q. Fair enough.

In your declaration, you described the visual fit of imagery to three-dimensional objects based as scientifically meaningless, did you not?
A. Yes, sir.
Q. And you say that a scientific solution is possible only through something called -- I'm going to quote you here -- "eight parameter projective transformation that requires, at a minimum" -- and you italicize the word "minimum" -- "four non-colinear points in the plane where a solution is desired."

Did I get that right?
A. Yes, sir. That's a technical version of what I was previously describing today.
Q. Okay. Well, if you don't mind me saying so, sir, I found

your declaration very highly technical. I had to read it several times.

But Mr. Terpstra's 3D scanning method produced millions of 3D data points, didn't it?

A. Yes.

Q. Not just four. Millions?

A. Yes.

Q. And much of the complex mathematical calculations that you describe are actually done in the 3D software that Mr. Terpstra used. Am I right?

A. Say that again.

Q. Much of the complex mathematical calculations you've been describing and that you describe in your declaration are actually performed in the 3D software Mr. Terpstra used?

A. Absolutely not. Laser scanner develops a cloud of three-dimensional data points in three dimensions. What I was referring to in an apertometer projector transformation is transforming the plane of an image to the plane in object space, and that's an entirely different concept from a laser scanner.

Q. But they can both produce the same sort of end result, can't they?

A. No. No. With an image to transform one plane to another, that's all you get is a transformation to another plane where you can locate the position of objects in that single plane. A

laser scanner gives you discrete and precise positioning of each data point in three dimensions. So it's apples and oranges.

Q. That was going to be my next question. It sounds like we're talking about an apples-and-oranges situation here, aren't we?

A. In this context? Yes, sir.

Q. Now, you said you're not familiar with the Autodesk 3D Studio Max software?

A. Correct.

Q. You've never used it?

A. No.

Q. You don't know its capabilities?

A. Correct.

Q. You don't know how it computes and plots points in 3D space?

A. Sure I do. I know how you can take three-dimensional data and display it on a screen in a CAD program.

Q. Okay. And that is what the program -- the Autodesk 3D Studio Max software does; right?

A. Yes, sir. Given the data points.

Q. Okay. Now, you describe in your declaration traditional cartographic aerial photography.

A. Yes, sir.

Q. Which uses a very special camera, does it not?

A. Indeed. They generally start at around a quarter of a million and go up.

Q. And that camera runs on a timer to take overlapping photographs at specified intervals?

A. Yes, sir.

Q. And it's a very high-quality camera?

A. Yes, sir.

Q. That takes discrete framed images?

A. Most of them do. Some of the newer models take a moving image, akin to what's called a Sonay (ph) camera, that was used in Word War II, in the Korean War, where, as a single piece of film, 200 for 500 feet long, it's a single image that rolls as the plane is flying along. Usually for reconnaissance after a bombing run.

Q. And the planes that are used to take the aerial cartography photographs, they fly at a specified designated altitude?

A. Yes, sir.

Q. Which is typically what?

A. No such thing. Depends on the purpose.

Q. Okay.

A. Generally, the altitudes vary from 1,500 feet above natural ground to develop one foot contour topographic maps to 12- to 24,000 feet to develop 1-to-50,000 scale topographic maps.

Q. So it just depends on what they're trying to develop?
A. Whatever the engineer needs.
Q. Okay. And the camera itself has a built-in mechanical commentator to correct for things like movement and image smear?
A. Many do. Since, I'd say, the 1980s. Prior to that, they did not have the technology developed.
Q. But they do now?
A. Yes, sir.
Q. And assuming we've got a post-1980s camera, it's there?
A. Yes, sir.
Q. But we're not dealing with a cartographic airplane in this case, are we?
A. No, sir.
Q. We're dealing with -- or a cartographic camera for that matter?
A. Probably not.
Q. We're dealing with an FBI surveillance plane?
A. Yes, sir.
Q. Now, the pilot of a cartographic plane probably doesn't care much if people on the ground know that he's flying overhead. Would you say that's probably true?
A. Unless they're shooting at him.
Q. Fair enough.
In a noncombat setting, it's probably safe to say that the

pilot of a cartographic plane doesn't much care if people know he's there?

A. True.

Q. Not so much for an FBI surveillance plane, though; right?

A. I guess.

Q. The pilot of an FBI surveillance plane may not want people on the ground to know that they're there?

A. Sounds plausible.

Q. So sometimes they have to fly at a higher altitude relative to the ground?

A. One would think so.

Q. And shoot at an angle, rather than directly overhead. And by "shoot," I mean capture images.

A. I guess. I don't know that to be a fact.

Q. And is it fair to say, Mr. Mugnier, that the imagery from a camera on the FBI surveillance plane is not of the same quality that you're used to seeing with the cartographic images from cartographic planes?

A. Absolutely.

Q. But that's the nature of forensic work, isn't it, you work with what you have?

A. Yes, sir.

Q. Sometimes what you have is not the best quality?

A. Correct.

Q. But you've got to go with what you get?

A. Indeed.
Q. And you do the best you can with it?
A. Yes, sir.
Q. Even if the imagery may be less than ideal?
A. Yes, sir.
Q. Now, in your declaration, you refer to the camera matching work that Mr. Terpstra did as eyeballing; right?
A. Correct.
Q. And I think you used the word "specious" to describe his placement of the vehicles and people on his 3D model.
A. Yes, sir.
Q. And you criticize him for failing to take into account such things as the superelevation of the roadway and the crown on the payment of the roadway?
A. Yes, sir.
Q. But you're aware, though, aren't you, that both the total station measuring device and the 3D scanner that Mr. Terpstra used automatically record that data and take those things into account?
A. The data collection devices do. Yes, sir.
Q. Okay. And Mr. Terpstra's 3D model relies not just on a single image from one perspective, does it?
A. Say that, again, please.
Q. His 3D model that he created doesn't just rely on a single image from one perspective, does it?

A. According to his report, you are correct.
Q. It relies on multiple camera matches taken from multiple angles?
A. Yes, sir. Multiple guesses.
Q. Multiple images from multiple camera angles is what my question was.
A. Yes, sir.
Q. Okay. And, in fact, when he matched -- when he placed the vehicles, he used a dozen different camera images from a dozen different angles; correct?
A. Each with a demonstrative error.
Q. A dozen different images from a dozen different perspectives; right?
A. Yes, sir.
Q. And that means that those -- those vehicles he placed had to match from 12 different perspectives; right?
A. To the eyeball.
Q. And he used three separate camera matches to place the people on the scene; is that right?
A. That's what he claimed.
Q. You have no reason to doubt it, do you?
A. In terms of success? Yes, sir.
Q. In terms of what he used?
A. Yes, sir. I question that because each was a monoscopic point, and you can't do that with a single eyeball on a single

image.

Q. I gotcha.

All right. Now, you also mentioned that you can't mathematically solve for something that is not resting on a known ground surface; correct?

A. When we're talking about a single image and we're using the -- either the graphical or analytical version of the eight parameter projector transformation, all you get is a position of -- relative position of objects in contact with that plane in object space.

Q. Okay. Are you familiar with a software program called Pix4D?

A. No, sir.

Q. How about Agisoft PhotoScan?

A. If I'm not mistaken, I think that is an Israeli software package.

Q. But are you familiar with it or not?

A. Not really.

Q. How about PhotoModeler Scanner or PhotoModeler?

A. PhotoModeler. I'm vaguely familiar with it. It's written in Canada.

Q. Have you ever used it?

A. No, sir, I would not.

Q. You would not or you have not?

A. Would not.

Q. Okay. And how about VisualSFM? Are you familiar with that?

A. Never heard of it.

Q. So you don't know -- you're not aware, for example, that each one of those four software programs doesn't require something to be on a planar surface in order to plot its location in 3D, in space?

A. Must be make-believe. Because if it's not mathematically possible with those two equations I just referenced to you several times, it can't be done. You can make it look good, but it's all baloney.

Q. All baloney? Okay.

So you have not used the PhotoModeler software, you said; right?

A. No. I use a competing package.

Q. I see. And what would that be?

A. Two of them. One would be iWitness, written by a friend of mine who's a professor of photogrammetry at the University of Melbourne, and PC Giant, which is a forensic and aerial photography package that I wrote myself and published and sold in the '90s, but I stopped selling it when the world went to Windows.

Q. Is that a Mac-based program?

A. No. DOS.

Q. Now, I want to talk to you a little bit about the

stereoscope test that you just demonstrated for the Court.

And in order to do that, if you don't mind, I would like to collect up the different samples that are floating around the courtroom so I can see the rest of them.

A. Sure. Yes, sir.

THE COURT: Here.

THE WITNESS: Certainly.

MR. SUSSMAN: Thank you. Thank you.

BY MR. SUSSMAN: (Continuing)

Q. Sir, just so I can be clear here, the one that I was originally given, which has got a sticker on the back saying "8-01, page 71 to 72," this has actually got the word "top" written along this one edge, but these are all horizontal photos. So just so I understand what's going on here, if I -- if I turn the photos so the photos appear in their proper perspective, in other words, in a landscape perspective, the word "top" is to the left. So would the -- would -- I don't know how to do this on the record, but I just want to make sure that the two photos that I'm touching right now are the two originals. Is that correct? Did I get that right?

A. That's correct.

Q. Okay. Good.

A. The word "top" refers to the way to hold the board to view it with a stereoscope.

Q. Got it. Okay.

So let's start with this one that I took a look at to begin with. I'm going to use the Elmo here. And let me grab my notebook real quick.

All right. So just to get some foundational knowledge underway, you said that what you did was to take the images either in .jpg or .pdf format out of Mr. Terpstra's report?

A. Yes, sir.

Q. So did you have the report digitally, or did you have the report in print version?

A. Digitally.

Q. Okay. So did you take the digital images to the -- Walgreens, I think you said?

A. Yes, sir.

Q. And had them make some prints from that?

A. Yes, sir.

Q. At what resolution did they print those?

A. Beats me.

Q. Beats me too.

Okay. Now let's take a look at what I've got displayed here, which is board number 8-01, page 71 to 72. This is one of your samples that you used with your stereoscope test; is that right?

A. Yes, sir.

Q. And as it is appearing on the screen in front of you now with the word "top" to the left --

A. Yes, sir.
Q. -- the two photographs on the left, the top left and the bottom left, those are the two duplicate originals; right?
A. Yes, sir.
Q. And by "duplicate originals," I mean they are -- they are two of the identical image that do not have any of the 3D vehicles placed on them?
A. Correct.
Q. And as we look at those vehicles on the top and the bottom left, they are clearly two-dimensional objects, are they not?
A. Say that again.
Q. The vehicles in the top left photo and the bottom left photo are very clearly two-dimensional; right?
A. Yeah. In the plane of the -- the paper print.
Q. Right.
A. Yes, sir.
Q. Yes.
A. Sure.
Q. But in the bottom right-hand corner, where you've got the 3D overlays --
A. Yes, sir.
Q. -- those vehicles were originally rendered in three dimensions in a three-dimensional computer program; correct?
A. One would think so.
Q. Does one know?

A. No, I don't.
Q. Okay. Would you accept my representation that these were created in the Studio Max 3D program?
A. Sure.
Q. All right. Sorry. Autodesk 3D Studio Max program.
So they're rendered originally in a 3D program in three dimensions?
A. And projected into a 2D image.
Q. And compressed into a 2D image.
Now you've got, clearly, 3D objects that have been slapped down and compressed into the 2D image, and then we're wondering why they don't look the same as things that started out in life as 2D and are still 2D; right?
A. No.
Q. Doesn't surprise you?
A. I'm not wondering at all.
Q. I'm not wondering at all either, and I'm not sure it's because there was error in placement so much as that there is just -- it's an apples-and-oranges comparison here.
A. No.
Q. No?
A. No.
Q. Okay. So now if you'd look at the vehicle with the two open doors in the right bottom center of the bottom right image.

A. Uh-huh, yes.
Q. Do you know which vehicle I'm talking about?
A. Yes.
Q. It's the vehicle pointing toward the left, toward the V of the other two vehicles?
A. Yes, sir.
Q. With two doors open.
Now, if you look at that same spot in the top image, do you clearly see that vehicle there?
A. Clearly? No.
Q. It's behind foliage, isn't it?
A. Some of it. Yes, sir.
Q. Likewise, with Mr. Finicum's truck? It's partially obscured by foliage in the top image; isn't it?
A. Yes, sir.
Q. But in the bottom image you have the 3D vehicle plopped right on top of the foliage for this demonstration photograph here; right?
A. Yes.
Q. Okay. Likewise, on this board here, 8-01, page 59 to 60. I'm going to -- let's see. Where is this one? Great.
In this one, top is actually top. And the top two images, the top left and the top right, those are just identical two-dimensional photographs; right?
A. Right.

Q. And the bottom right, the four vehicles shown there are clearly two-dimensional images; right?

A. Yes, sir.

Q. But the bottom left, those are, again, the three-dimensional images that were taken out of a three-dimensional computer program, that are designed to be viewed on a three-dimensional program's visual display on a computer screen put into a photograph; right?

A. You are calling a rendering in two dimensions as three dimensions designed to be viewed on a screen as three dimensions, but, in fact, it's not. You can only view a computer screen in 3D if you have two images that are different and you are wearing crystalized glasses that switch back and forth about 20-some-odd times a second so that you can view stereoscopically in 3D.

3D is 3D. When you give a perspective view, that's still a two-dimensional view.

Q. Okay. All right. I'll give you that one. I used sloppy language, and I'm certainly not a three-dimensional expert.

But when I look at the two photographs, the bottom left and bottom right, on the bottom right I am seeing what clearly looks like a photograph to me. On the bottom left, those vehicles don't look like photographs to me. Would you agree with me on that?

A. I'll agree that you don't know what you're talking about.

You refuse to use this to view them yourself. And as I was showing the Court, if you blink between the left and right eye, and you do this several times, you can see that the superimposition of the edges of the superimposed image do not match the original photographic image and the difference is evident to you even if you don't care to view them stereoscopically. You can blink back and forth and see the difference. You can see the difference in every one of these things I did from Walgreens. It's a simple task that anyone with vision in both eyes can tell if they use a simple device like a stereoscope. You can always use a stereoscope to see for yourself.

Q. And when Mr. -- when Mr. Francis was asking you questions on direct exam, did I hear you correctly to say that when you were asked about camera match photogrammetry you say that your opinion would be, quote, pretty much as a layman in that area?

A. Yes, sir.

Q. Okay. Because you've never done it yourself, have you?

A. Correct.

MR. SUSSMAN: Okay. That's all I have. Thank you.

MR. FRANCIS: Your Honor, I would offer this demonstrative collectively as 11-03, and I have no further questions.

THE COURT: Thank you. They are received.

Thank you, sir.

Our next witness.

MR. MALONEY: The government re-calls Toby Terpstra, Your Honor.

THE COURT: Thank you.

TOBY TERPSTRA,

called as a witness in behalf of the Plaintiff, being previously duly sworn, is examined and testified as follows:

THE COURT: You are already under oath. Continue.

THE WITNESS: Thank you.

MR. MALONEY: Do you need a minute to set up?

THE WITNESS: Yeah. If you don't mind, that will be great.

THE COURT: Take your time.

THE WITNESS: Thank you.

THE COURT: Let us know when you're ready.

THE WITNESS: I'm ready.

MR. MALONEY: Are you ready?

THE WITNESS: Yes. Yes.

DIRECT EXAMINATION

BY MR. MALONEY:

Q. Mr. Terpstra, you were present for Mr. Mugnier's testimony just now?

A. Yes, I was.
Q. Are you aware of any studies that validate or test the use of a stereoscope to study and validate a 3D camera match alignment?
A. No, I'm not.
I guess I'll qualify. I mean, we work in different industries, so it's certainly possible that that paper exists. I'm just not aware of it.
Q. Within your industry, have you ever seen a stereoscope brought to bear on a 3D model?
A. No, I have not.
Q. And this morning I think we were looking at some of the overlay data involving Mr. -- or Deputy Turpen's data and your 3D scan data. Do you have that accessible, and can you bring that up for the Court?
A. Yes.
Q. And you mentioned at the break that you had some thoughts about RGB with respect to Mr. Liscio's testimony. Can you explain what you mean by that?
A. Sure. So "RGB" is -- just stands for "red, green, blue," and, honestly, it's just a photograph. Right? So photographs are made out of those three channels. Red, green, and blue. Each pixel is defined by a certain amount of red, green, or blue to create color for that pixel on a screen. Right?
In 3D scanning, the 3D scanner that we've been talking

about, that can create millions of 3D data points at a scene, what it does to capture those points -- and I think this may have been described already, so I apologize if this is repeat -- but what it does to take those 3D points is it's measuring the time for the light to be reflected back to the device. So it has a highly accurate clock on it that can determine distance based on that time. It's also recording a horizontal and a vertical angle to get that point.

So what the scanner will do, that instrument will go through and record all these different millions of different 3D data points. And then at the end of that, so that it's not just black and white, so the -- in fact, what you see on your screen is reflectivity data collected by a 3D scanner.

Q. Let me stop you there.

A. Yes.

Q. What's reflectivity data? Explain what that means.

A. You bet. So the reflectivity or the intensity of light that is bouncing back from the surface -- so on the roadway surface here you can see -- I'm going to plug in my mouse here real quick too. I apologize. On the roadway surface you can see there's two different colors for -- or grayscale values, I should say, a light and a dark. Right? Well, the lighter color represents higher amounts of light that are returning to the scanner. So it's more intense. So that reflectivity is reflected in the grayscale coloring here that you see in the

point cloud.

Q. Okay. How is that a consideration when viewing --

THE COURT: Wait until he gets --

THE WITNESS: I apologize.

THE COURT: That's all right.

THE WITNESS: I apologize. As you can imagine, working in 3D software with a mouse pad is difficult. I need the mouse.

THE COURT: I just know you can't do two things at once.

THE WITNESS: I appreciate that as well.

MR. MALONEY: Okay.

THE COURT: Here we go.

BY MR. MALONEY: (Continuing)

Q. Now that we know what the reflectivity values are in the context of the RGB --

A. The point cloud.

Q. -- point cloud, explain how that can impact how you view and -- view this 3D model you've created.

A. Okay. So, again, as it relates to the point cloud and the data that we're looking at here, the reflectivity, that's the data that's collected by the LiDAR device first. And then after it's collected, all those 3D data points, it then goes back and takes photographs. So, again, the RGB values.

So you're able to project, after you've -- as part of

processing 3D scan data, you're then able to take and project those photographs onto the scan in the processing of the 3D scan data so that you get a more photorealistic scan. Right? And that's what we've been seeing previously, the coloring on the roadway surface versus the grayscale. So that was the RGB data.

Now, unfortunately, sometimes the -- the photos are limiting the resolution, right, so depending on your model of scanner and all of that, the photographs themselves are a little bit limited in their resolution. And when they're projected onto this point cloud -- so we have highly accurate 3D data points, and the reflectivity that's coming back from the scanner, that's direct data recorded from the scanner.

Unfortunately, the photographs, as you project them on top of this point cloud, is not always as precise as you would like them to be. Sometimes there could be, like, bleeding of pixels from one point to the next, that kind of thing, so you don't get as accurate of a representation of the point clouds with the photographs on top of them as you do if you just look at the reflectivity data itself.

Q. Is that why you store this data to display in various layers?

Let me withdraw that question.

Can you view that data and that layer, the other data on top of it, or remove the other data from that in the model?

A. So I think I understand your question. I'm going to select the point cloud here real quickly, and hopefully it will refresh on the screen here a little bit too.

So there's different ways you can view it. Here you see I just turned on a normal ramp. Rather than describe what that is, it's just another way of viewing with different colorization. So, yes, I suppose you could think of it as layering, but there's different options for viewing a point cloud.

Did I answer your question?

Q. Yes. And how does that affect -- or how does that impact how you place and position the models and character in the -- in the virtual space?

A. Yeah. So knowing the limitations of projecting these photographs onto the point cloud data itself, we always work with the grayscale version, which is what you see here, when we're doing camera matching, when we're doing photogrammetry working, right, because we want to work with the best and most accurate data possible. And that's what you see here.

So the -- this is the same model that Mr. Liscio had up previously. The only difference is instead of displaying it with the RGB or photograph overlay on it, now you're seeing it with just reflectivity data. Again, this is how we used it when we were doing the camera matching. So errors that were pointed out in alignment, in my mind, have some to do with that

or all to do with that.

So if I zoom in on or maximize this view port here -- one second. I apologize.

Okay. So as I maximize this view port here, you're now able to see -- I believe this is the area that Mr. Liscio was pointing out and the lane lines and how they were not aligned between my survey or Kineticorp's survey, the black lines represented here, and the point cloud or grayscale values and the paint marks that are visible in the point cloud. So if I hide the line work, you can see here in grayscale or recorded in the intensity values from the scanner paint marks in the shape of Ts that represent where the vehicles were at their points of rest.

You can see those clearly in our model here.

As I unhide that, now you can see that same -- that survey data. I'll make that more visible for you as well. This is survey data overlaying that.

Q. Now, the Ts that we're seeing, what -- that we're seeing on your screen, what did those represent? The Ts on the roadway.

A. So it's -- I would say just because I've seen a number of different police forces and their methods for documenting either crime scenes or accident reconstruction scenes, it's a very common method for marking the tire location or wheel location for a vehicle or what we'd refer to as a point of rest

for the vehicle.
Q. So the one part of the "T" goes along the tire and the other cross on that "T" is at the axle?
A. Yeah, that's correct.
Q. And what is being displayed here? Is that an actual mark on the road that your scanner picked up?
A. Yes, it is.
Q. And what is the significance of that mark to you as you were placing the vehicles in the scene?
A. Honestly, it's a good starting spot. Right? I know that after I've camera matched and found good agreement between both the imagery that I'm using as well as the 3D model, the point cloud survey, I can then begin working on placing pieces of evidence. In this case, the 3D models of the vehicles. Right?
So to place those in 3D space, I have this great reference that's right there in the data. I can start with that. I can place the vehicles such that it is aligned with its wheels on the roadway surface and oriented or rotated about these different paint marks on the pavement.
Q. Can you show us how you do that, or can you -- can you display the vehicles in that view relative to those marks?
A. Yes.
Q. Can you zoom in on that truck there?
A. (Witness complies.)
Q. Now, there was much discussion about the overlay of the

Deputy Turpen data with Mr. Liscio. Do you have any thoughts or insights on that -- that issue?

A. Well, I can say that I've worked with police data from a number of different police agencies and survey data. In my mind, the most accurate data is going to be data that's collected reflectorless because you don't have the potential error that can come from poling such as the user is holding the pole or the prism on top maybe slightly out of plumb or not quite level.

If you can imagine, if you're holding a pole that's not quite level and you're trying to record a point down on the pavement, that's going to be in the wrong location on the pavement. Right? It's going to be misrepresented. I'm not suggesting huge amounts of error here. Right? It's -- people are -- can hold things level pretty well. But there's also the potential for movement while that point is being recorded by a total station.

So the collective amount of total station data collected by the police, I -- total of 57 points, I would say, in general, is quite accurate. And especially considering the methods that the police force is typically recording these for. So accident reconstruction, I believe Mr. Turpen was -- has taken courses in accident reconstruction and is certified as a trooper to work with -- within that area of expertise.

A total station survey for that purpose is going to be

very accurate. When it comes to accident reconstruction, if you're off by an inch or two, or even a few more, it's typically not going to affect your speeds of the vehicles, which is, in general, one of the main things that an accident reconstructionist is looking for.

Does that answer your question?

Q. Yes.

Mr. Liscio testified about the ellipsoids for movement or as a test or range of certainty within a 3D model. Do you have thoughts about that?

A. Yes. I agree with his assessment. As far as describing your error in a 3D model and its placement, you can consider it in -- or I should say six different ways. Right? You have translation in X, Y, and Z axes, so left and right, up and down. Right? Or perhaps I can say that it -- there's probably better ways of describing a 3D coordinance system, but X, Y, and Z.

And then, similarly, in rotation, you have roll, pitch, and yaw. And each one can be considered. I did not consider all of those in this case. What I considered was the ones that would be most favorable, as I understand the case and its -- its nature, most favorable to the defense.

In other words, I moved the vehicle forward and backward such that it would affect the trajectory and where that trajectory would be aligned to in the model.

I did not consider moving it left or right as much because moving it left or right, as you can imagine -- and if you will allow me to unhide the trajectory here real quick, I'll make this a visual demonstration. Probably a lit bit easier to understand.

Okay. So if I was to move this more to the left or the right, more towards the passenger's side or the driver's side, as you can imagine, what is going to happen, the trajectory itself is not going to move much in relation to the parties involved.

Does that make sense?

Q. Yes.

A. The same is true from a rotational standpoint. If I'm moving it up or down or -- I should say if I'm rolling the vehicle, it's probably not going to change it too much; but if I'm yawing the vehicle, it will change it in the most significant way as related to these trajectory marks. So I looked into both moving the vehicle forward and backward, and I looked into yawing, as those are the most important -- at least in my mind, the most important values in a 3D space that would affect this model the greatest.

Q. And did you bring a paper to my attention during the break?

A. I did.

Q. And it was hot off the presses. Not my 1998 printer, but

a different printer. Gave it to Counsel. I believe Mr. Liscio --

MR. MALONEY: I think we have a collection of experts up here, Judge, in the jury box. We might get to hot-tubbing yet -- but I believe he was reading that as well --

A. Yes. I believe so.

Q. -- while Mr. Mugnier was testifying.

But what is this study from 2018?

A. So this is a paper I wrote with Kineticorp, and it, at least in my mind, will help to satisfy some of the critiques Mr. Liscio brought up. I believe one of his was the idea of a blind study. And the fact that nothing had been published or, perhaps, very little literature existed for a blind study where individuals were asked to ascertain or come up with a photogrammetry solution independent of each other and the results were compared, this paper --

Q. Can I interrupt you just --

A. Yes.

Q. What form of camera matching were you using with this blind study? Was it a manual camera match?

A. Yes. I mean, I guess I would suggest -- yeah, manual camera matching, yes.

Q. Okay. Because we've had lots of different types of camera matching talked about today. This -- your study, in 2018, was a blind study involving manual camera matching?

A. That's correct.

Q. Describe the study.

A. Okay. And if it's all right, I would -- I'll bring up a couple of imagery pieces while I talk about it.

THE COURT: That's fine. Go ahead.

THE WITNESS: Okay. So this paper looked at two things. And I'll get the title to you guys here real quick. This is "Using Multiple Photographs and USG LiDAR to Improve Photogrammetric Accuracy." So this paper covers a number of different things, and rather than just jump right in and find that you guys are missing, kind of, steps and perhaps confused, I'll explain briefly a couple of the other things that were researched so that when I get to the end with the blind study and the individuals and their results, we can understand that a little bit better.

I'll show this real quick. USGS -- and this is something I'm sure Mr. Mugnier is familiar with, but the U.S. Geological Society has a 3D elevation program where their -- the topographical maps are historically something that the USGS Society was tasked for creating for the Continental United States. And now they're moving towards this LiDAR.

So, similarly, we've been talking about the 3D laser scanners that create point clouds of data. Now this is becoming publically available for people to use and download.

So what you see in front of you is not surface geometry.

Those are individual 3D points that are publicly available online through the USGS website, and it's part of their 3D elevation program that they're -- sorry, that they started.

A quick example of how that's collected. So they're collecting these through planes or aerial LiDAR.

I'm sorry. I'm not sure why that's not displaying. Okay.

So here is a quick animation just to show -- again, just so everybody is familiar with the data sets we're using in this paper. This is USGS LiDAR. And, specifically, what this paper looked at is how one might ascertain 3D locations for objects in a scene that's very difficult to place them.

For instance, this scene. We have an edge of pavement in the foreground that you can see. Right? It's not a distinct point, though, right, that establishes a line. We also have a bush. And aside of those two things, there's very little in this scene that could be considered discrete points that would be useful both from the 3D model and with the photograph itself to achieve this camera match overlay. Right?

I'll skip through some of this, but here is -- here's a little bit more about the study. So here we have three photographs that were taken from the roadway or approximately the roadway surface, and we're locating four cones out in this field, and we're also locating a vehicle, right, and positioning all of those.

So the idea of this paper is to consider each one of these

photographs individually, and we had five -- five photograph -- photogrammetry experts from Kineticorp individually match each one of these three photos independent of each other. And then we also had to match them together. We had them match without the scan data in the background. The USGS. You can see an image on the left, and then we had a match with that, and we compared the results of all four of those studies.

So single photograph, three photographs, and then with limited LiDAR and USGS LiDAR. And we also have the individual and the combined for each.

So I'll walk through the results here real quick, and hopefully that makes sense to everybody. So accurate --

THE COURT: Don't speak real quick. You'll have a court reporter frowning at you.

THE WITNESS: I'm sorry.

THE COURT: Go ahead.

THE WITNESS: So here what you're looking at is a total station survey. You have the bush out here in the middle, and I'll circle that real quick. There's not much data to work with, again. And we have, as you can see in those photographs, maybe edge of pavement. A couple of them contain a fog line, but nothing very discrete as far as a unique 3D point.

Then we had gone through and placed a -- these four cones, as well as the vehicle, and surveyed those. Now, those were

kept as a separate data set so that the individuals would come up with a solution for each one of those positions independently and without the knowledge of their actual physical locations.

Here is what that data set looks like combined. So we've combined the USGS point cloud in the background. We have the total station survey in the foreground.

Here is an example of a camera match that was done. Here you can see we have yellow lane lines that are matching. And what I'm describing to you as a match is the line work. Right? So at this point we're just showing total station survey data. And here is what the USGS LiDAR data looks like in the background.

So what the paper is presenting is the ability to use topographical or -- yeah, topographical LiDAR data in the background to help inform a camera match.

But, specifically, as it relates to this case -- and here is a couple images that just show the incredible resolution available, which is, at least in my mind, amazing. You're able to pick out individual trees and foliage in this 3D LiDAR.

Okay. So let's talk about the results of this study a little bit. Hopefully everybody understands we have five different individuals that were asked independently to come up with a photogrammetry solution. Right? That is why on this image on the left you can see there's a number of different

colors. So the blue colors represent the actual locations of the vehicle and the four cones, and then you can see there's a smattering, like a plot study, I guess, of different points surrounding those 3D data -- those blue points where the physical locations were, those represent the different users, and they also represent the different photographs.

So we'll have a user that is, you know, each different color represented there and where there's solution for each one of those cones and the vehicle was. That's why there's such a large amount of colors represented there.

Hopefully that makes sense to everybody.

Paul, are you tracking with me?

BY MR. MALONEY: (Continuing)

Q. We're following you. Let's see if we can get to your conclusions here.

A. Okay. I apologize.

Next image on your right here you can see multiple photographs, so we've moved from a single-image photogrammetry solution to multiple all at once. So then the users were told, "Look, here are your individual locations for the cameras. Let's combine those all into one file. Now use those to help inform the other matches."

So, similar to this case, we're using 12 cameras now in the study. Going from one image, now we're going to three different photographs or three different images. Right?

And you can see the grouping here gets a little bit tighter. Right? It's not perfect, by any means, but it's a little bit tighter.

And then what I've done is I've kind of outlined those areas so you can see the results a little bit more clearly.

All right. Now, here we are with USGS LiDAR in the background. Now, again let me describe to everyone this is not an ideal situation. You don't have a lot of points to work with. You do not have a point cloud of unique specific details in front of you. You don't have, like, roadway scenes recorded by a 3D laser scanner. The 3D point cloud that you see in background of those images was USGS LiDAR, and it's not dense enough, typically, to show those details.

But you can see the results that we're getting at much closer. So, in this case, we found -- and I'll page down here. These are, kind of, the improvements that were shown over each one of them; but, bottom line, what I want to -- everybody to understand is for the placements of each one of these cones, the average distance was -- that we found was 13 inches from their actual locations, over 165 feet, with a percent error based on that of .6 percent.

Again, an unideal situation, not as much data to work with as in this case.

Q. And you -- by "not as much data," you mean the LiDAR is not as rich as the 3D scan data that you performed in this --

you collected in this case?

A. Yeah. Not only the 3D scan data, but details visible in the photograph that correspond to that data, yes, such that a match can be obtained.

MR. MALONEY: Thank you, sir. Those are all my questions.

MR. FRANCIS: Your Honor, can we take five minutes, please?

THE COURT: Yes. Thank you.

MR. MALONEY: Do you want more than five minutes? Judge, we sprang this paper on them over the lunch hour. If they need more time, I want them to have it.

THE COURT: I'm sorry. I couldn't hear you.

MR. MALONEY: Your Honor, I gave Counsel this paper right after the lunch hour. I want him to have the time that he needs with his expert to review it and make sure he's prepared to cross-examine the witness.

MR. FRANCIS: Five minutes is fine. That's no problem.

THE COURT: Whatever it takes.

MR. FRANCIS: Thank you Your Honor.

(Recess taken.)

THE COURT: Stay seated. Just have a seat. Okay. Go ahead.

CROSS-EXAMINATION

BY MR. FRANCIS:

Q. Hello again, Mr. Terpstra.

A. Hello.

Q. Thank you very much for your clarification on some of the points earlier in your examination. I just have a few questions for you about this study.

I'm showing you part of page 2 of the study. Do you see that there on the screen?

A. I do.

Q. This is another paper that you wrote. I think you described earlier, correct, you're one of the authors on this?

A. This paper?

Q. This paper.

A. Yeah. Yeah. I'm the author, yeah.

Q. The overall accuracy of evidence placement within a camera match depends on lens distortion correction as one of the factors you listed there; correct?

A. Correct.

Q. When you described earlier that this scenario was not an ideal situation -- am I quoting you correctly?

A. Are you referring to the paper or --

Q. The experiment. The experiment.

A. The experiment, yes.

Q. And you're referring there to the quality of the points,

the LiDAR and the point cloud data; correct?
A. No, I'm not.
Q. What are you referring to when you say it's not an ideal situation?
A. I'm referring to the fact that we do not have good discrete points throughout the scene to align to; so, for instance, the bush I pointed out in that one photograph, aside from the USGS data in the background, it may have been the only really recognizable discrete data point.
Q. You do have good quality photographs for this experiment, though?
A. Yes, indeed.
Q. You have a situation where all of the objects that you're trying to measure are stationary?
A. That's correct.
Q. And they're all touching the ground?
A. That's correct.
Q. Could you do me a favor, please, and pull up -- I'm going to switch the camera back to your computer. Could you pull up and tell me when you're ready to switch back?
The figure from -- it was in some kind of a display you were showing. I didn't see it in the paper itself, but showing the -- the different results that you're -- that the different examiners got. The before and after, you averaged them all together. Do you know what I'm talking about?

A. I believe.
Q. I'll switch back to your computer.
A. Is this the slide you're referring to?
Q. No. That's the chart that summarizes it at the very end. We might get to that later.
If you could just scroll up, I can see on the left-hand side there what you're doing. I'll tell you when to stop. Slide 31, please.
Yes. Thank you. If you could put that in presentation mode so we can all see it full screen?
A. You bet.
Q. Thank you.
Now, I just want to make sure I understand what we're seeing here.
So each of these blue dots in the middle here -- and I understand I'm coloring it blue. I'll take that away in a moment. Each of those blue dots in the center of those circles I've just drawn, that represents the right answer. The true location of, I think, in this case, mark the cone?
A. Yes. They represent the center of the cone on the terrain surface.
Q. All right. And each of the multicolored dots around that blue dot -- the green dots, the red dots, the orange dots -- those all represent what camera matching told one of your professional photogrammetrists the right answer was to them?

A. Yes. As they solved for the locations of the traffic cones and the vehicle, that's where they placed them.

Q. And, presumably, each of these people thought that the images lined up to them when they placed these colored dots -- when they -- when they've solved for the position of these cones resulting in a placement of a colored dot?

A. To the best they could.

If I can qualify that statement?

Q. I think you've answered the question. To the best they could. That makes sense.

These are professional photogrammetrists; right?

A. Yes.

Q. And they work for your company?

A. That's true.

Q. And on average, this experiment found an error of 13 inches?

A. Yes.

Q. Sir, did you add plus or minus 13 inches to each of the people and each of the vehicles in this case?

A. No, I did not.

MR. FRANCIS: Thank you very much. No further questions.

THE COURT: Anything further?

MR. MALONEY: No, Your Honor. Thank you.

THE COURT: Thank you, sir.

Just one quick question. Maybe it's objectionable. If it is, don't be bashful. I'm -- it's not clear to me what your error was that you wanted to correct, and have you -- that's the first question. That's the preliminary.

THE WITNESS: Yes.

THE COURT: Have you now a succinct answer as to what your correction would show?

THE WITNESS: Yes, I believe so.

THE COURT: Do you --

MR. MALONEY: No objection, Your Honor.

THE COURT: All right. Go ahead.

THE WITNESS: So the error that is in my report --

THE COURT: Yeah.

THE WITNESS: -- and the error that's --

THE COURT: Whatever you wanted to correct.

THE WITNESS: Yes. What I want to correct has to do with information that was provided to me -- the syncing. I used syncing at a different point in time. So my model is accurate. It's precise, but it's for the wrong point in time. So I would like to correct it for the time that has been identified by Mr. Piazza to be the right point in time.

THE COURT: So what would the difference be?

THE WITNESS: The difference -- it would change the -- any individual that was moving during that point in time would have a slightly different position.

So, again, as we're talking about nine frames or about a third of a second, any movement that those individuals had over that time frame would be represented -- instead of it being nine frames before that, which we currently have, it would be at the time of shot five.

THE COURT: Does it change your testimony as -- your conclusion?

THE WITNESS: I don't believe it will, but I would love the opportunity to do the analysis to --

THE COURT: You ran out. We don't have that right now.

THE WITNESS: Thank you.

THE COURT: Thank you.

THE WITNESS: Yes, thank you.

THE COURT: All right. Our next witness.

MR. MALONEY: The government calls Professor Jeff Smith, Your Honor.

THE WITNESS: Good afternoon, Your Honor.

THE COURT: Yes, sir.

MR. SMITH: I don't plan on using my laptop for any demonstratives, but I don't want to be caught offguard if the opportunity arises.

THE COURT: Take your time.

MR. MALONEY: Sir, after you're settled, can you stand and raise your right hand and be sworn?

DEPUTY COURTROOM CLERK: Sorry.

JEFFREY SMITH,

called as a witness in behalf of the Plaintiff, being first duly sworn, is examined and testified as follows:

THE WITNESS: I do.

DEPUTY COURTROOM CLERK: Thank you. Have a seat.

THE WITNESS: Thank you.

DEPUTY COURTROOM CLERK: You've been in the courtroom, so you know to scoot forward. First and last name. Spell your name for the record, please.

THE WITNESS: Jeffrey Smith. J-e-f-f-r-e-y. S-m-i-t-h.

DIRECT EXAMINATION

BY MR. MALONEY:

Q. Good afternoon, sir. Where do you work?

THE COURT: Once again, let's just take one task at a time.

THE WITNESS: Okay. I work at the University of Colorado Denver at the National Center for Media Forensics.

BY MR. MALONEY: (Continuing)

Q. Do you have a private -- do you also have another business that you own?

A. I do. I'm a partner in Forensic Media Services.
Q. And is -- was your CV submitted to the Court as Exhibit D to ECF No. 87?
A. Yes, it was.
Q. And was your partner's also submitted as Exhibit E?
A. The CV of Dr. Catalin Grigoras? Yes, it was.
Q. Yes. And did you also offer a report that was provided to the Court in Document ECF 87 as Exhibit F?
A. Yes, it was.
Q. All right. Now, your report examined an audio file, WJA lots of zeros and ending in 34.MP4?
A. That's correct.
Q. And is your understanding today different than your understanding at the time you wrote your report as to what that file is?
A. Yes, it is.
Q. What is your understanding today?
A. As I understand now, following the file that was notified by Mr. Piazza earlier this week, that his synchronization is file 0000002.mov.
Q. Did you examine that file, as well, the file number ending in 02 that Mr. Piazza identified as his sync?
A. Yes, I did.
Q. Is that appreciably different than the file that you examined in this report?

A. I will tell you the difference.
Q. Okay. Is there a difference in the sync between those two files?
A. Yes, there is.
Q. And is it measurable?
A. Yes, it is.
Q. What's the difference?
A. There's a nine-frame difference between the synchronization of the two files.
Q. And both of these videos are 30 frames per second?
A. That's correct.
Q. So it's about a third of a second different?
A. That's correct.
Q. And, otherwise, is -- with that correction, that file 000002 is the actual Mr. Piazza sync, and this file you examined, ending in 34, is the Deschutes County synchronization. With that correction, is your report otherwise true and accurate?
A. Yes, it is.
Q. And are your opinions contained in that report?
A. Yes, they are.

MR. MALONEY: Your Honor, we would offer those as exhibits for the purposes of this proceeding.

THE COURT: Yes. It's received.

///

BY MR. MALONEY: (Continuing)

Q. Have you reviewed some of the expert reports and materials in this case?

A. Yes, I have.

Q. Have you reviewed those for both the government and the defense expert witnesses in this case?

A. Yes, I have.

Q. Is that report that the Court has now received a statement of your opinions relevant to those reviews?

A. Yes, it is.

Q. Now, you stated that there was a nine-frame difference between the Deschutes County version of the synchronized file in this case and the Mr. Piazza synchronization that was done in this case. Was there another synchronization that you reviewed in this case?

A. In my report, I mentioned a synchronization conducted by the FBI.

Q. So is that -- is there a difference between the FBI synchronization and Mr. Piazza's synchronization?

A. There is. A difference of one frame.

Q. And your stated range of certainty to the -- to the synchronization that Mr. Piazza achieved, is that in your report?

A. Yes, it is.

Q. Even though it's different for the files?

A. Regardless of the files.
Q. Okay. What is that synchronization range for you?
A. 34 frames.
Q. So a little over a second?
A. That's correct.
Q. And that means that as the videos are playing, they're always within a second of one another, the two videos in each file, the Cox video and the FBI surveillance video?
A. Much less, yeah. Three tenths of a second. I'm sorry. I think I misunderstood your question, but --
Q. Can you explain what you mean by 34 frames?
A. Yes. A reliable synchronization between the Cox video, which is inside the truck, and the aerial video by the FBI fixed-wing aircraft, is a range of 34 frames, based on the area of interest during the -- the -- shots four and five. And that range of interest is developed by the visual information between the two videos.
Q. Now, you didn't have Mr. Piazza's frame count when you performed this analysis, did you?
A. I did not.
Q. And, yet, you were still able to analyze the video and achieve a range of certainty for the reliability of the synchronization?
A. Yes, one can easily identify the frame synchronization that Frank Piazza developed visually.

Q. And did you also review Mr. Piazza's audio analysis in this case?
A. Yes, I did.
Q. And is there any evidence of that review that -- in that review of shots four and five, from an audio perspective, that there's evidence of an echo?
A. No, there is not.
Q. Could the second shot of that shot four and five be an echo of shot four?
A. What Mr. Piazza has identified in his report as shots four and five are indeed two distinct gunshots.
Q. Why, sir?
A. They are nearly identical in their amplitude envelope.
Q. Did you see any evidence of an N-Wave?
A. No, I did not.
Q. Should an analysis for an N-Wave have been done to determine the timing of the gunfire in this case?
A. Not with regard to synchronizing these two videos.
Q. Why is that, sir?
A. Because the synchronization can be done visually and should be done visually because the aerial photography has -- doesn't -- doesn't have an audio track. So once the visual synchronization is made, then the -- the location of the gunshot should be apparent.
Q. Is that based on the visual cues that you saw in the

video?
A. Correct. And then aurally the gunshot specifically shattering the window.
Q. Did you compare the amplitudes for both shots four and five?
A. Yes, I did.
Q. What did you find?
A. That they are nearly the same.
Q. Why is that significant?
A. If one were an echo of the other, the second being an echo of the first, it would be lower in amplitude.
Q. Which would be preferable in this case to analyze the audio of -- broadband or narrowband spectrographic analysis?
A. It depends on the task.
Q. To determine the timing of the audio events, specifically the gunfire, which would be preferable?
A. A narrowband spectrogram will give a better degree of frequency. So, therefore, in order to determine the timing, a wideband spectrogram should be used. But you can see the timing of the gunshot within 100 milliseconds between the two different types of spectrograms.
Q. Which type is your understanding that Mr. Piazza used?
A. I would say it's between a wideband and a narrowband, just visually looking at his plot. Since there are actually several options for the bandwidth, not just two.

Q. And did you also have a chance to form an opinion about the synchronization that Mr. Piazza did?
A. Yes, I did.
Q. Are you aware of any scientific studies or peer-reviewed articles for forensically synchronizing two videos based upon gunfire?
A. No, I'm not.
Q. Are you also experienced in 3D reconstruction?
A. Yes, I am.
Q. And did you review Toby Terpstra's report in this matter?
A. Yes, I did.
Q. Did you offer your opinion in your report that has been submitted to this Court?
A. Yes, I did.
Q. In summary, did you find his work reliable?
A. I do.
Q. Did you review Mr. Liscio's criticisms in -- from his first and second declarations in this matter?
A. Yes, I did.
Q. And did you form an opinion about Mr. Liscio's criticisms of Mr. Terpstra's 3D model?
A. Yes.
Q. What is that opinion?
A. That while primarily the criticism is that -- and we've heard it today -- that the model created by Mr. Terpstra is

highly subjective. And while there are subjective elements to the creation of the model, it has an objective underpinning that is computationally rich with the 3D laser scan and coupled with a -- a fairly rigorous self-validation within the report of his data, I find that criticism to not be enough to dissuade the -- the determination that Terpstra's report and model is reliable.

Q. So do you find it based on sound scientific principles?

And by "it", I mean Mr. Terpstra's model and the methods that he used.

A. Yes.

Q. And did you review Mr. Mugnier's criticisms of the photogrammetry work that was done in this case?

A. Yes, I did.

Q. Do you have an opinion about that?

A. Yes, I do.

Q. Can you please inform the Court of your opinion?

A. As summarized in my report, the -- most of the criticisms that were raised are with regard to not conducting a mathematical derivation of the measurements in the model. However, the model itself is point cloud and, as opposed to using nine -- nine -- I'm sorry. I can't remember the terminology used by Mr. Mugnier -- to derive one plane with a three-dimensional point cloud of millions of points, planes can be derived from that information directly.

Same effective result or opinion in my letter regarding Mr. Mugnier's criticisms that they are -- are not enough to dismiss the reliability of Mr. Terpstra's report.

Q. Do you perform your own 3D scene reconstruction as part of your work with your company?

A. Not for casework, no.

Q. Okay. You're familiar with the process?

A. Yes, I am.

Q. And do you use manual camera match photogrammetry in your work?

A. No, I do not.

Q. Okay. Do you find it to be reliable?

A. I find Mr. Terpstra's application of it in this situation to be reliably demonstrated. I found his demonstration yesterday, too, to depict that.

Q. Is it something that's repeatable and testable?

A. Yes, it is.

Q. Is it accepted within the community of 3D scene reconstructionists?

A. I'm not sure. I can't speak to that myself.

Q. Can you talk a little bit about forensic media investigations and working with nonideal data, I think is how you put it in your letter.

A. Sure. As I'm sure Your Honor is well aware, in forensics situations, we have recordings, which is my primary area of

expertise, audio and video image analysis. We have recordings that are created spontaneously. Even if they're implemented recording devices, they're following or tracking someone.

In forensics, we don't have the luxury of well-placed recording devices. Therefore, it's common in forensics and, indeed, expected to work with data in a reliable way and appropriately. And I wouldn't want to say that any data should be considered for any case; but when recordings are obtained that are less than ideal, like I said, which is normal in forensics, that material has to be worked with and a person that's trained in the analysis -- that's expected -- to determine whether or not a -- a reliable analysis can be made.

There's -- there's a lot of areas where we've developed in the forensic sciences over many years, and one of those areas is in measurement analysis of forensic imagery, and the 3D scene reconstruction of an environment is a -- certainly more cutting-edge than -- than some of the past analyses, and it represents an evolution of that technology.

And, yeah, I think -- I think that answers your question.

Q. Okay. And based upon your work in this case, your training and experience in the field of forensic 3D scene reconstruction and camera match photogrammetry, did you form an opinion to a reasonable degree of forensic 3D scene reconstruction certainty as to the reliability of the methods Mr. Terpstra used for his 3D scene reconstruction in this case?

A. As a forensic scientist, I found the application reliable.
Q. Similar question. Based on your work in this case, your training and experience in the field of forensic media analysis, did you form an opinion to a reasonable degree of forensic audio/visual certainty as to the reliability of the methods Mr. Piazza used to identify when the gunfire incidence occurred in the Cox video?
A. In this particular situation, the aural and visual identification of gunshots is sufficient and reliable.
Q. And similar question to a reasonable degree of forensic visual certainty, as to the reliability of the methods Mr. Piazza used for his video synchronization in this case.
A. Yes.
Q. And what is that opinion?
A. That the synchronization conducted by Mr. Piazza is reliable.

MR. MALONEY: Thank you, sir.

CROSS-EXAMINATION

BY MR. FRANCIS:
Q. Good afternoon.
A. Good afternoon.
Q. Perhaps I didn't hear it in Mr. Maloney's list at the end there, but I noticed that earlier you mentioned -- I thought I heard you push back when you were asked if Mr. Terpstra's

methodology was reliable, and your answer was "It's reliably demonstrated." What is the distinction between those two concepts, in your mind?

A. In reviewing his report, I found the application and the internal validation rigorous and demonstrative of reliability. I myself did not conduct the analysis.

Q. And apparently you're not able here today to say under oath that it's reliable, merely reliably demonstrated?

A. No. I -- I'm -- I would be happy to -- to say that I, in reviewing his report, his finding is reliable.

Q. Okay. You describe yourself primarily as an expert in audio. Would that be a fair assessment?

A. In multimedia forensics.

Q. You have a master's of science of recording arts?

A. That's correct.

Q. Your thesis was on the accuracy and consistency of spectrographic analysis for voice identification?

A. That's correct.

Q. We can go through your articles, if you would like, but is it fair to say that the vast majority of your publications are on the subject of audio analysis?

A. I would not say the vast majority, no.

Q. The majority?

A. Over 50 percent, yes.

Q. Okay. Are you a professional photogrammetrist?

A. No.
Q. I think I heard you mention you don't do casework in accident reconstruction yourself. Is that right?
A. No, I do not.
Q. And you also don't use camera matching at all in your own work?
A. No.
Q. Have you ever testified on the subject of photogrammetry?
A. No, I have not.
Q. How about camera matching?
A. No, I have not.
Q. All right. Let's discuss some things in your field of primary expertise. If you could take a look at your report. And let's go to your first finding on page 2, which you just testified about. Now, there's been --
A. If I could get a copy of it or --
Q. Oh, I'm sorry. Do you not have a copy of your report in front of you?
A. I have it on my computer. I could bring it up.
MR. MALONEY: In your witness binder there, sir.
BY MR. FRANCIS: (Continuing)
Q. You know what? We'll put it up on the screen for you. So perhaps that will solve the problem. One moment.
A. That will be the easiest.
MR. FRANCIS: Thank you. If we can bring up pages 2

and 3 side by side, please.

BY MR. FRANCIS: (Continuing)

Q. My apologies, Professor, we're having technical difficulties here.

There we are?

MS. OAKLEY: Which page?

MR. FRANCIS: Can we bring up pages 2 and 3 side by side, please.

That's fine.

BY MR. FRANCIS: (Continuing)

Q. So, Professor, there's been some discussion that what you did here with regard to the synchronization of the two videos was to validate Mr. Piazza's sync of the FBI video to the Cox video. Isn't it true, sir, that you do not specifically state that any one specific synchronization is correct to the exclusion of all other possibilities?

A. That's correct.

Q. Okay. And, in fact, your report on page 3 concluded that the synchronization used by Mr. Piazza was reliable. That's the term you used?

A. That's correct.

Q. And by "reliable," what you mean is that it falls within a particular 34-frame range?

A. That is correct.

Q. Okay. And, in your opinion, you would call any

synchronization of these two videos that falls within that 34-frame range reliable?

A. I would also -- that is correct, and I would also add that we have three data points, and we could consider that any video synchronization which is closer to the -- the density of where those three data points are would -- would be considered even more accurate.

Q. Fair enough. But I'm asking you about your definition that you've given of "reliable" that you use in your report.

A. That is correct.

Q. All right. So anything within those 34 frames. That was the most that you were willing to refer to as reliable as an audio expert?

A. It's important to note that that is inarguable, the method by which I derived those 34 frames, because the visual information between the interior of the truck and the aerial camera is -- is not shared. There -- at the point of interest, we can't see when the gunshot happens in the aerial video, which is why we're pursuing this question.

The synchronization, then, at that point of interest could be conducted upon the closure of the door, which, in the interior of the Cox -- the interior of the truck in the Cox recording is not clearly seen either. But it does happen either -- since I have my report here, it happens in the Cox video between frame 32311 and 34 frames later.

THE COURT REPORTER: I'm sorry. Could you say the number again.

THE WITNESS: It's in my report.

THE COURT: Can we get his report to him?

THE WITNESS: Yeah, I'm looking at it.

THE COURT: It looks to me like you're looking elsewhere.

THE WITNESS: There we go. Thank you.

BY MR. FRANCIS: (Continuing)

Q. Is that the right portion of my report that you're referring to there, sir?

A. Sure. The -- the bullet piercing the truck would occur between those 34 -- that 34-frame range, and that is a -- that's a conservative and inarguable range.

Q. Sir, thank you very much for that answer.

If I could return your attention to my question, which was you are not able to call reliable and you do not, in fact, call reliable any range of frame smaller than 34 frames in your report?

A. Not in my report, no.

Q. Okay. Now, you note in finding B, further down on page 3, that Mr. Terpstra created a 3D model of the scene; correct?

A. That's correct.

Q. And you go on to say that within this model the time at which the gunfire pierces the roof of Finicum's truck and

shatters the driver's side back window is important to determine which armed officers present were in a position to make the shot at that moment; correct?

A. That's correct.

Q. Is it now your understanding that Mr. Terpstra did not, in fact, use the frame that Mr. Piazza had picked out for him?

A. By name, he did not pick out Mr. -- I've since learned Mr. Piazza's frame that he identified as a gunshot.

Q. It would appear that neither did you.

A. That's correct.

Q. You note that the position of Special Agent Astarita does not look like it changes to you during these 34 frames?

A. That's correct.

Q. Is it your understanding that an issue in this case is whether Special Agent Astarita was in the cone that we've all been talking about?

A. Yes.

Q. Are you also aware that one of the issues in this case is whether anyone else besides Special Agent Astarita was in the cone as well?

A. Yes.

Q. Did the positions of any of the other individuals change during those 34 frames?

A. Yes.

Q. You note in your report that in forensics it is expected

to work with nonideal data.

One moment.

In forensics it is expected to work with nonideal data, which in multimedia forensics means we work with recordings and images captured in nonideal environments where recorded evidence comes as a result of tactical response, unmonitored surveillance, and/or spontaneous recording; correct?

A. Correct.

Q. Professor Smith, just because it is common to see nonideal data in forensics, does that necessarily mean that every use of nonideal data gives reliable and accurate results?

A. Certainly not.

Q. In fact, I think I just heard you say that we wouldn't want to say that any data could be used for any case?

A. That's correct.

Q. You go on to say that Mr. Terpstra's method relies on computationally aided processes using data from multiple sources as the foundation of the model.

You're referring there to the 3D laser scanner that generated the scene and the models of the vehicles and the people; correct?

A. That's correct.

Q. That's what you're referring to when you're talking about computationally aided processes?

A. That's correct.

Q. Are you aware that the issue that has been raised this week with regard to Mr. Terpstra is not how good of a model he made of a truck or of a scene but where he -- what he did to place those trucks and people into that scene?
A. Yes. I'm very well aware of that.
Q. That is the portion of Mr. Terpstra's work that you find subjective?
A. That is correct.
MR. FRANCIS: Thank you very much. I have no further questions.
THE COURT: Anything further?

REDIRECT EXAMINATION

BY MR. MALONEY:
Q. The -- you reviewed the video associated near the time of shots four and five?
A. Yes, I did.
Q. The people moving in the video on the roadway, are they moving in the direction of the cone, as you understand it to be positioned from Mr. Terpstra's report, or are they moving away from the cone?
A. Visually, by memory, I would say that they're moving perhaps alongside the cone, not towards or away from.
Q. Is there anyone else in the cone?
A. I don't think so.

Q. You stated that Mr. Terpstra's work was subjective.
A. That's correct. There are portions of it, of the process, that are subjective.
Q. But he would -- he did so and documented his work meticulously?
A. Documented and included a test of validity.
Q. And that was him moving the placed vehicles and characters to a point to see where they no longer were aligned with his photogrammetry -- with his camera match solution?
A. That's correct. As I understand the placement of the vehicles within the scene, as it is a subjective process, is done by eye, and moving from what would be considered a placement, a better placement, to the worst placement and taking that as a range of error.
Q. And what he did and how he placed those people were documented sufficiently so that someone else could review and check his work?
A. Correct.
Q. And repeat it or, at least knowing the procedure he used, repeat the procedure he used in order to achieve either the -- a result of their own?
A. Given the same data that Mr. Terpstra was working with, yes.

MR. MALONEY: Thank you, sir. No further questions.

THE COURT: Is that it?

MR. FRANCIS: Nothing further.

THE COURT: Thank you. You're excused.

THE WITNESS: Thank you, Your Honor.

THE COURT: Anything further?

MR. MALONEY: No, Your Honor. Government rests.

THE COURT: Anything further for the defense?

MR. FRANCIS: Nothing further, Your Honor.

THE COURT: All right. It's now 3:30. What is the pleasure of the parties as to going into argument? You have the option of doing so this evening, or we can do it in the morning. It's up to your preference.

MR. CARY: Your Honor, I have eight issues to cover that I think will take about 45 minutes at least, and my preference would be -- if we can't get it all done today, my preference would be that we both go in the morning, if that's available for the Court.

THE COURT: It's available.

Do you concur?

MR. MALONEY: We concur, Your Honor. I think I have about a similarly-in-length closing argument.

THE COURT: I'm not putting any time element on it. The timing -- I'll listen to your arguments. We should be through by noon, I would think, but, whatever. We'll pick up at 9:00. Is that agreeable.

MR. CARY: That is agreeable, Your Honor. I would

perhaps ask the Court's clarification. The government bears the burden.

THE COURT: I know that.

MR. CARY: And I -- I guess my question is who should go first. It would be our view that they should go first, given that they bear the burden and that there's been some changes.

THE COURT: We got the opening statements backwards, but we're not going to get the closing -- you go first. You respond.

MR. MALONEY: With the Court's pleasure, will I be permitted rebuttal?

THE COURT: Of course.

MR. MALONEY: Thank you, Judge.

THE COURT: Is there any other housekeeping as to anything?

MR. CARY: No. Not from the defense, Your Honor. Thank you.

THE COURT: Fine.

MR. MALONEY: No, Your Honor. Thank you.

THE COURT: Well, I thank you all for your brilliant preparation, and the organization has just been remarkable. I thank you, both sides, for that.

I'll see you at 9:00 in the morning. We're in recess.

Oh, one projection. I will not be announcing my opinion

or disposition from the bench. I'll be reviewing each expert individually. I will write a disposition. It will probably take me up to two weeks, but I'll have it in plenty of time, in the event we're going on to trial.

Thank you. We're in recess.

(Hearing adjourned.)

C E R T I F I C A T E

United States of America v. W. Joseph Astarita

3:17-cr-00226-JO

EVIDENTIARY HEARING

May 24, 2018

I certify, by signing below, that the foregoing is a true and correct transcript of the record, taken by stenographic means, of the proceedings in the above-entitled cause. A transcript without an original signature, conformed signature, or digitally signed signature is not certified.

/s/Jill L. Jessup, CSR, RMR, RDR, CRR, CRC

Official Court Reporter
Oregon CSR No. 98-0346

Signature Date: 6/11/18
CSR Expiration Date: 9/30/20